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King's Dome South Prospect

Bienville Psh, LA

Smackover Structure/Reef
Haynesville Shale
James Reef

Summary. In 2003, El Paso used 3D seismic to discover the Kings Dome Field by drilling the El Paso 1 Foster 35 well into an Upper James carbonate buildup at about 7500' TVD adjacent to the King Salt Dome. It has produced more than 5 BCF from this one well. Initial production approached 1 BCF/month. Its production dropped precipitously and now only produces 200 MCF/d. In 2006. El Paso used 3D seismic to discover gas in the El Paso 1 Pardee 34 well from a separate Lower James carbonate reservoir. This well has also produced more than 5 BCF and is currently making more than 6 MMCFG/d (5/08) at the same depth. BKE discovered that these James reefs continue along the west flank of a salt withdrawal syncline to the SSW based on 2D seismic, geological mapping and other datasets. Upon investigating the James, it was found that withdrawal syncline sits directly above a Smackover structural high that may be reefal - similar to the Cotton Valley Reefs in East Texas. Additionally, the salt withdrawal events fractured the ubiquitous Haynesville/Bossier shale significantly enhancing the deliverability of this gas resource formation. From one wellbore, all three formations can be evaluated. Total potential could surpass 50 BCF/well.

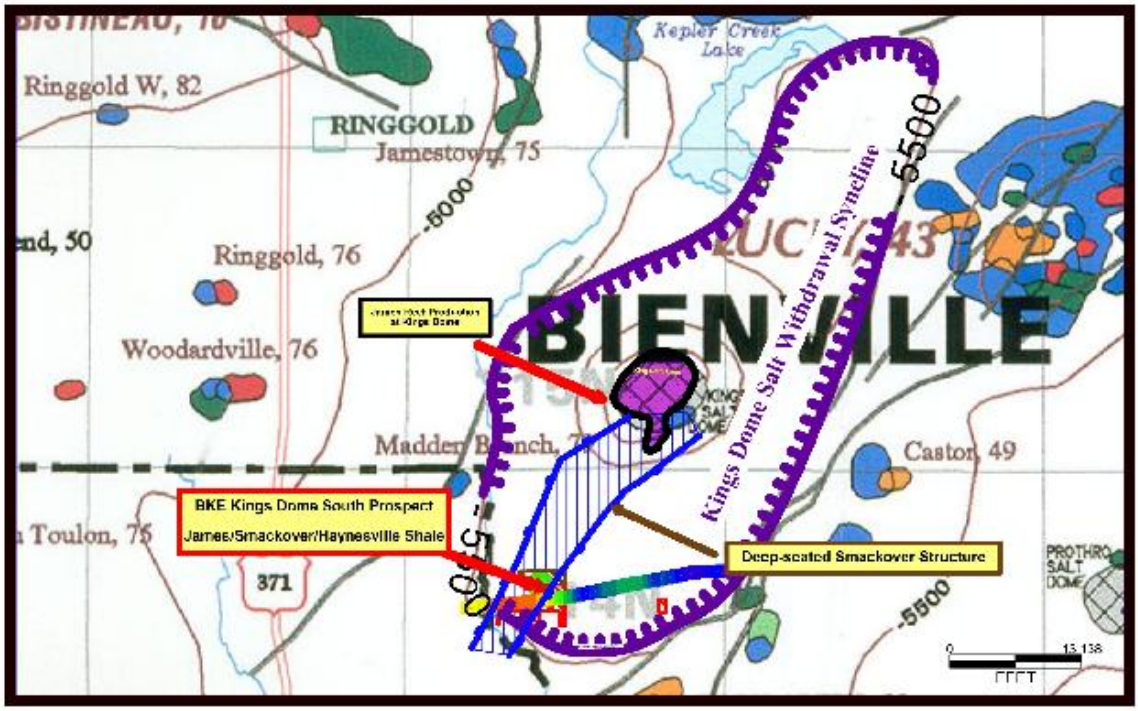
NOTE: MS Word or Web versions of this write-up. Just double click on figures to activate Adobe Acrobat which will open the detailed version of the figure. There you can view or print.

Smackover Structure/Reef(?) Prospect

Geology. The Cretaceous salt withdrawal syncline surrounding this prospect is easily found on Geomap products. The geohistory of the area can be interpreted such that this area originally had a salt supported Jurassic Smackover structural high block during deposition (Figure 3). Later during the Cretaceous, the salt evacuated part of the structural high as evidenced on the seismic line in Figure 8. QC'ing other lines along strike, the Smackover structure, in part, remains high and a viable prospect (Figure 2). It should also be noted that the Smackover block may also be topped by porous reef facies and similar to the prolific Cotton Valley reefs that produce on the west flank of the East Texas Basin. This is not an uncommon scenario where salt supported paleo-highs become structurally inverted via salt withdrawal. It is possible that this Smackover structural high that is now beneath the later Cretaceous salt withdrawal syncline is more than 3000 acres. The Cotton Valley Reefs produce between .2 and .7 BCF/acre. If that is the case here, then there may be between .6 to 2.1 TCF for the entire structure. Reserves expected would be between 5 and 50 BCF/well.

Kings Dome South Prospect

Bienville Parish, LA



James Reef - 5-30 BCF - 7600'
Smackover Reef(?) - 3-50 BCF - 16,000'
Haynesville Shale - 5 BCF? - 15,000'

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Figure 1. Salt withdrawal syncline around King Salt dome. Haynesville structural high/reef outlined in blue.

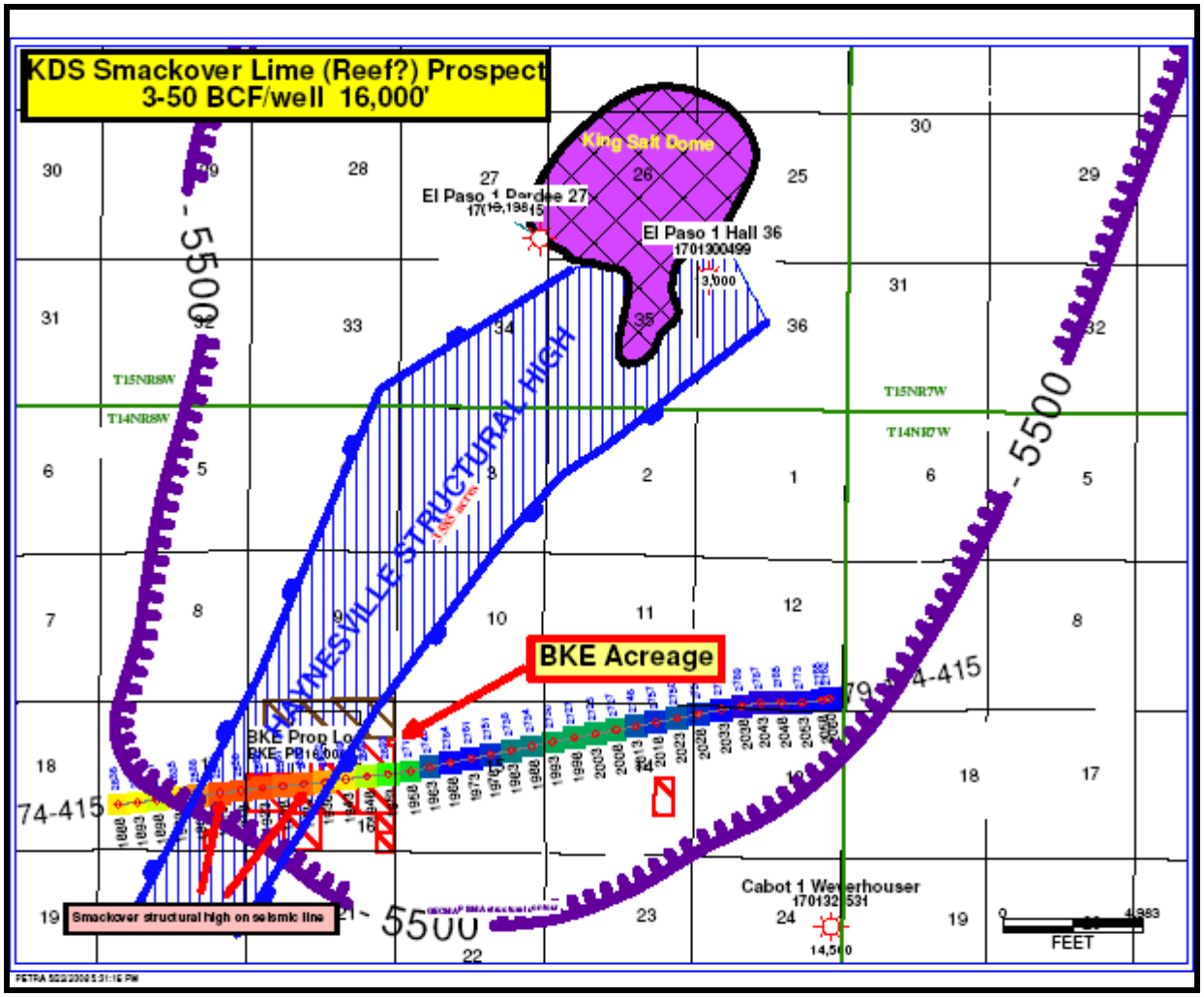

Figure 2. Closeup of salt withdrawal syncline with the Smackover structure outlined in blue and hachured. Note structural high location on seismic line and perfect co-location of axis of syncline and the Smackover structural high.

Seismic. The seismic line is pretty clear on how it should be interpreted (Figure 8). The salt withdrawal event created a west dipping normal fault that dropped a portion of the paleo-high down to the west. The Smackover horst block remains a viable drilling target. The withdrawal event was long lived and episodic. The seismic indicates that the most active time was from Hosston to Austin Chalk time.

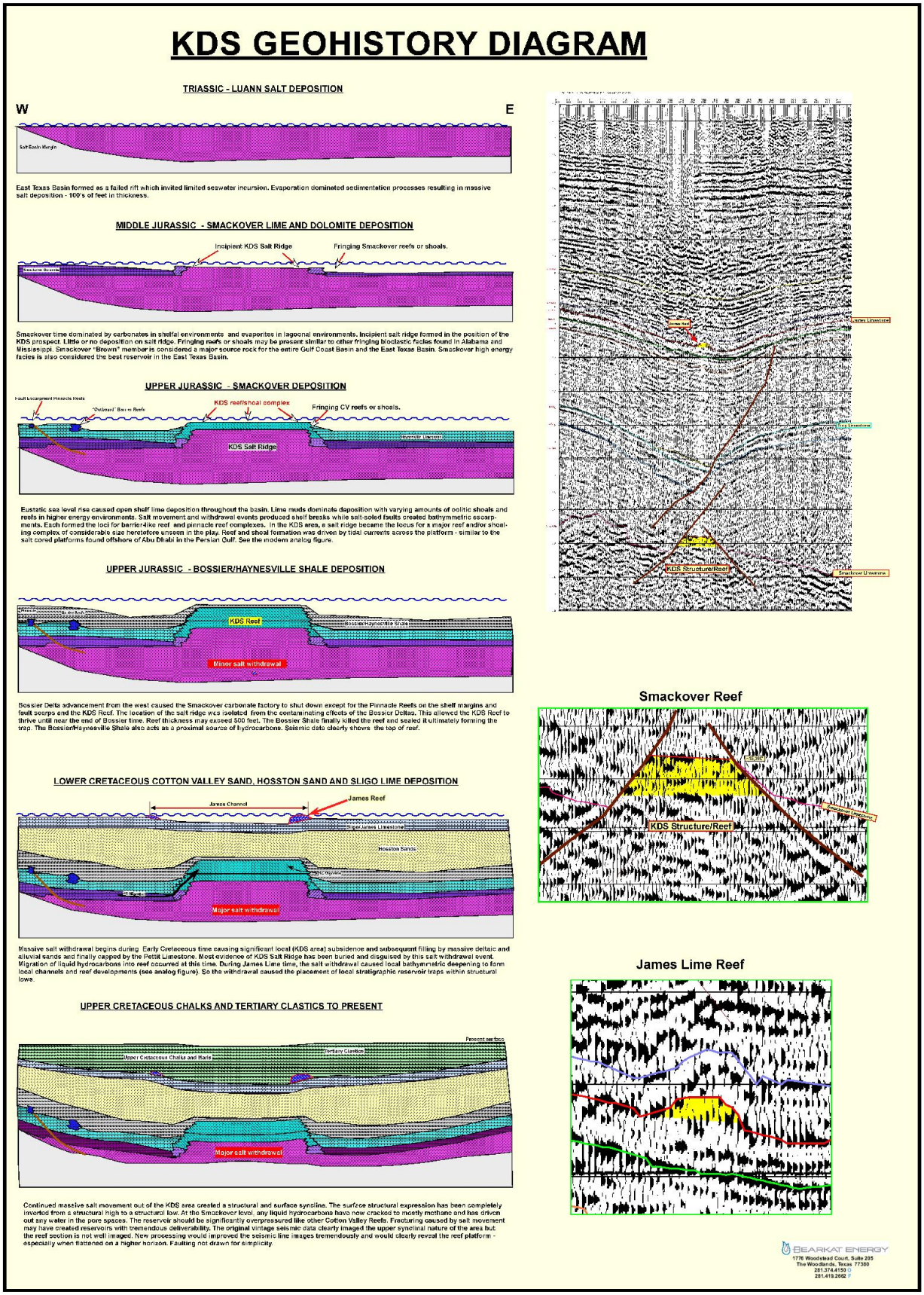

Figure 3. Geohistory diagram of the King's Dome salt withdrawal syncline. Salt evacuation caused water deepening in James time which allowed reefs to grow tall on its west flank. Smackover structure remains a high target.

Haynesville Shale Prospect

With Chesapeake's new Haynesville/Bossier Shale discovery, this sequence of organic shales is an additional target. This is especially so in this area where it is expected that the salt tectonics has significantly fractured these hydrocarbon rich shales. The interpreted seismic line in Figure 8 illustrates where the Haynesville is fractured in orange. Petrohawk has a large lease position to the northwest and has estimated 5 BCF/well on 60 acre spacing. BKE will has 300 acres under lease which allows 5 shale wells to be drill and theoretically book 30 BCF. Figures 4-7 are annotated PetroHawk displays extracted from their website. PetroHawk is one of several medium to large independent companies to get into the Haynesville Shale play.

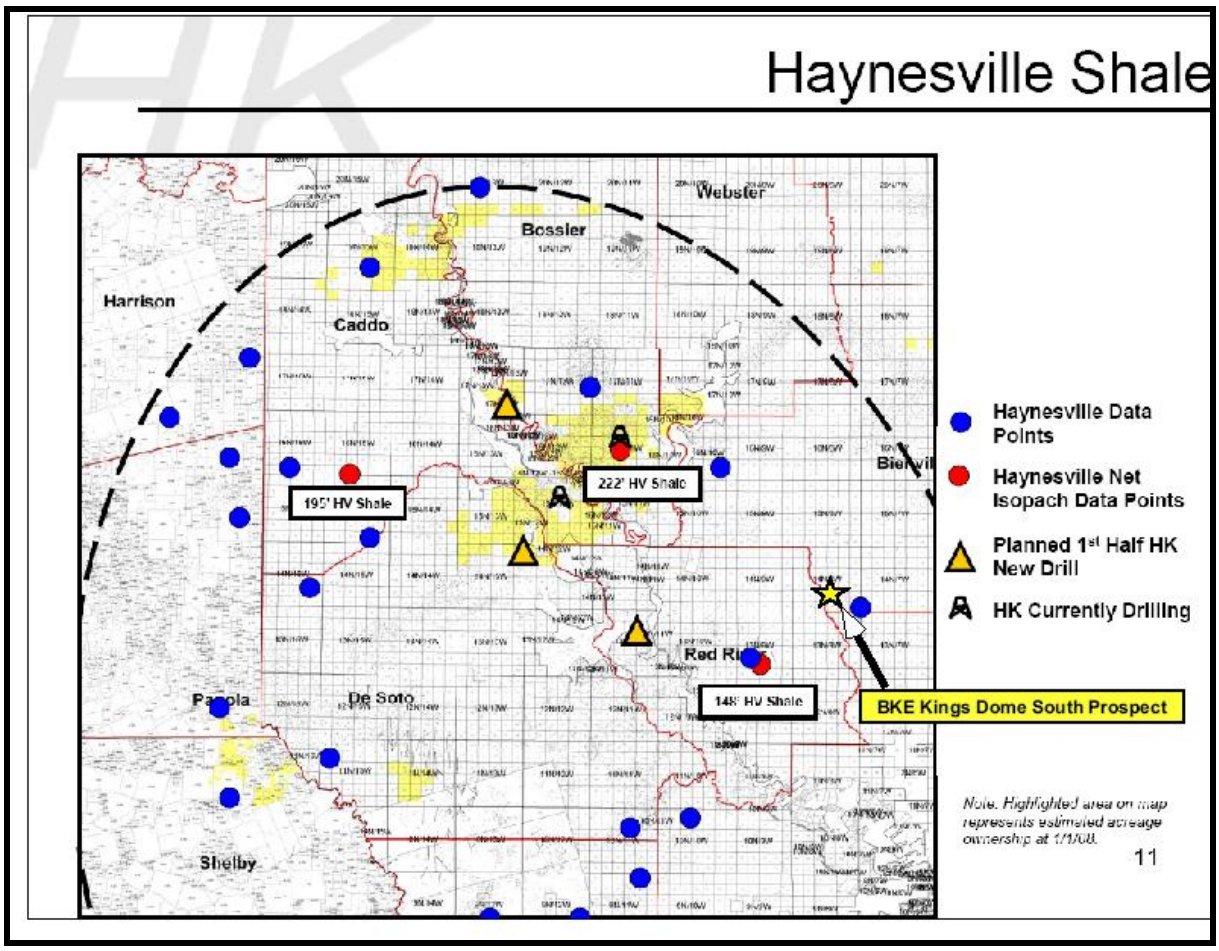

Figure 4. PetroHawk display of Haynesville Shale play with BKE prospect noted.

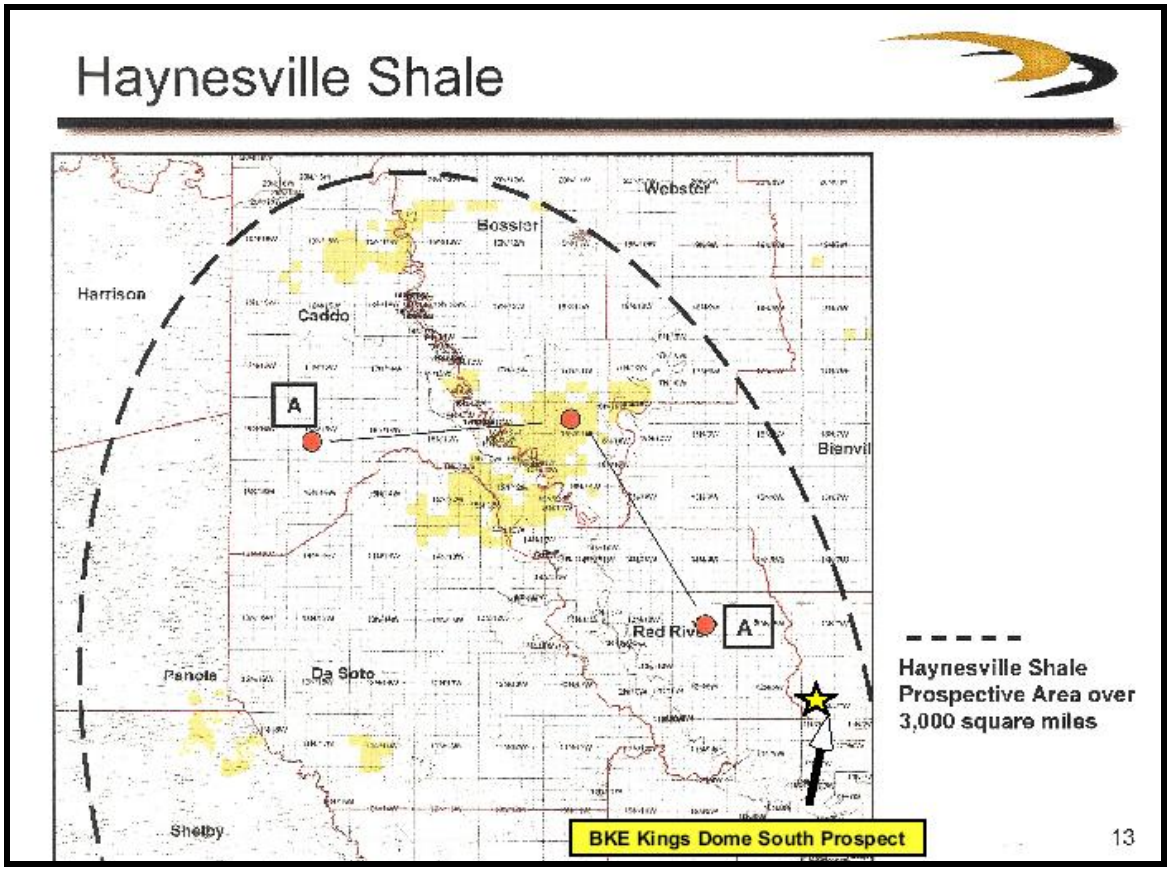

Figure 5. PetroHawk display of Haynesville Shale play with BKE prospect noted. Location of figure 6 cross-section.

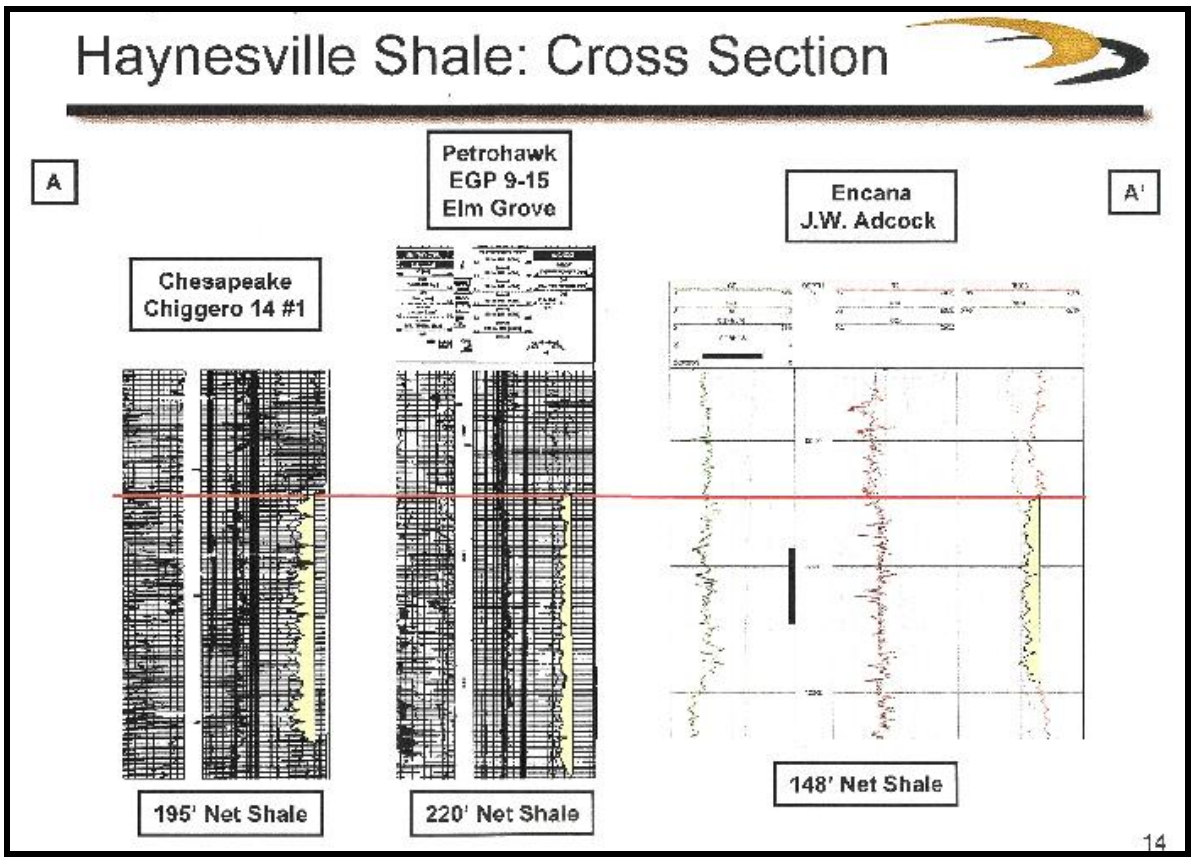

Figure 6. PetroHawk display of Haynesville Shale cross-section. Location in figure 5.

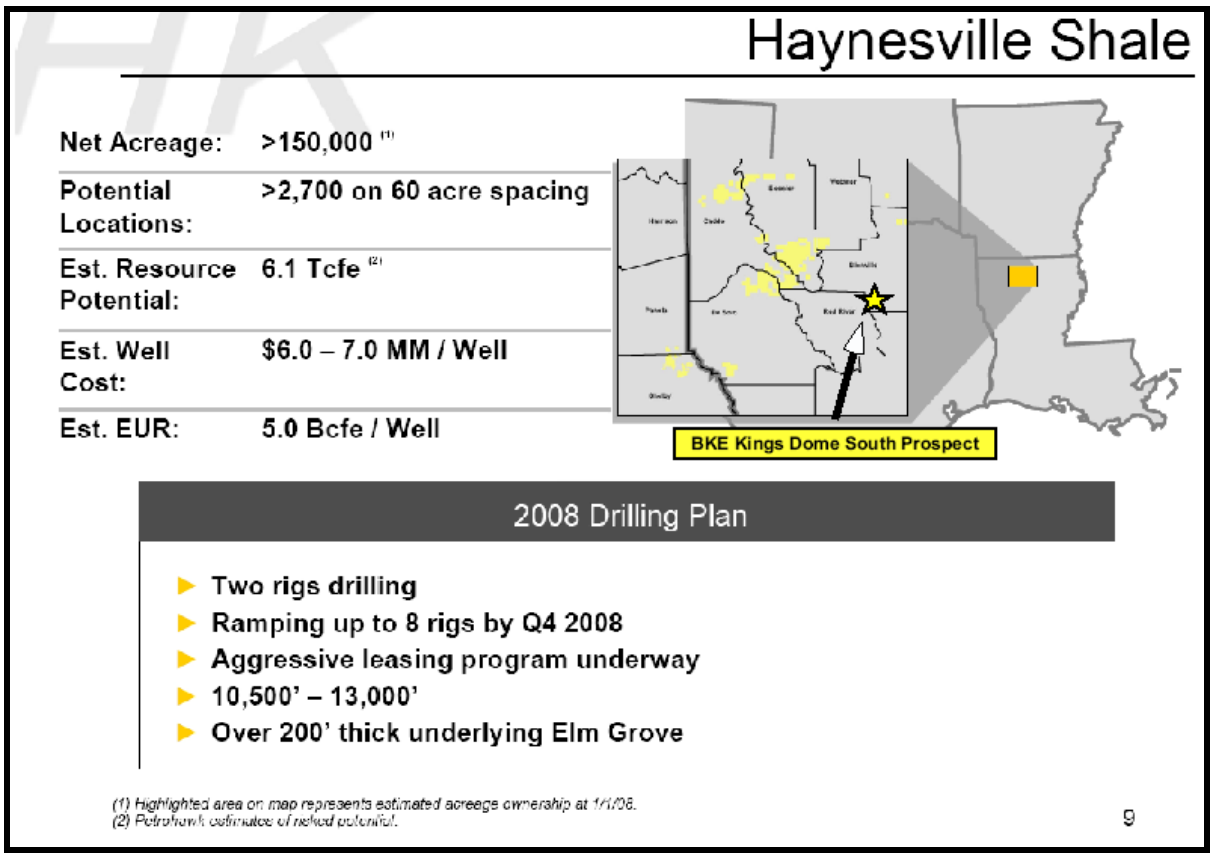

Figure 7. PetroHawk Haynesville Shale development plans.

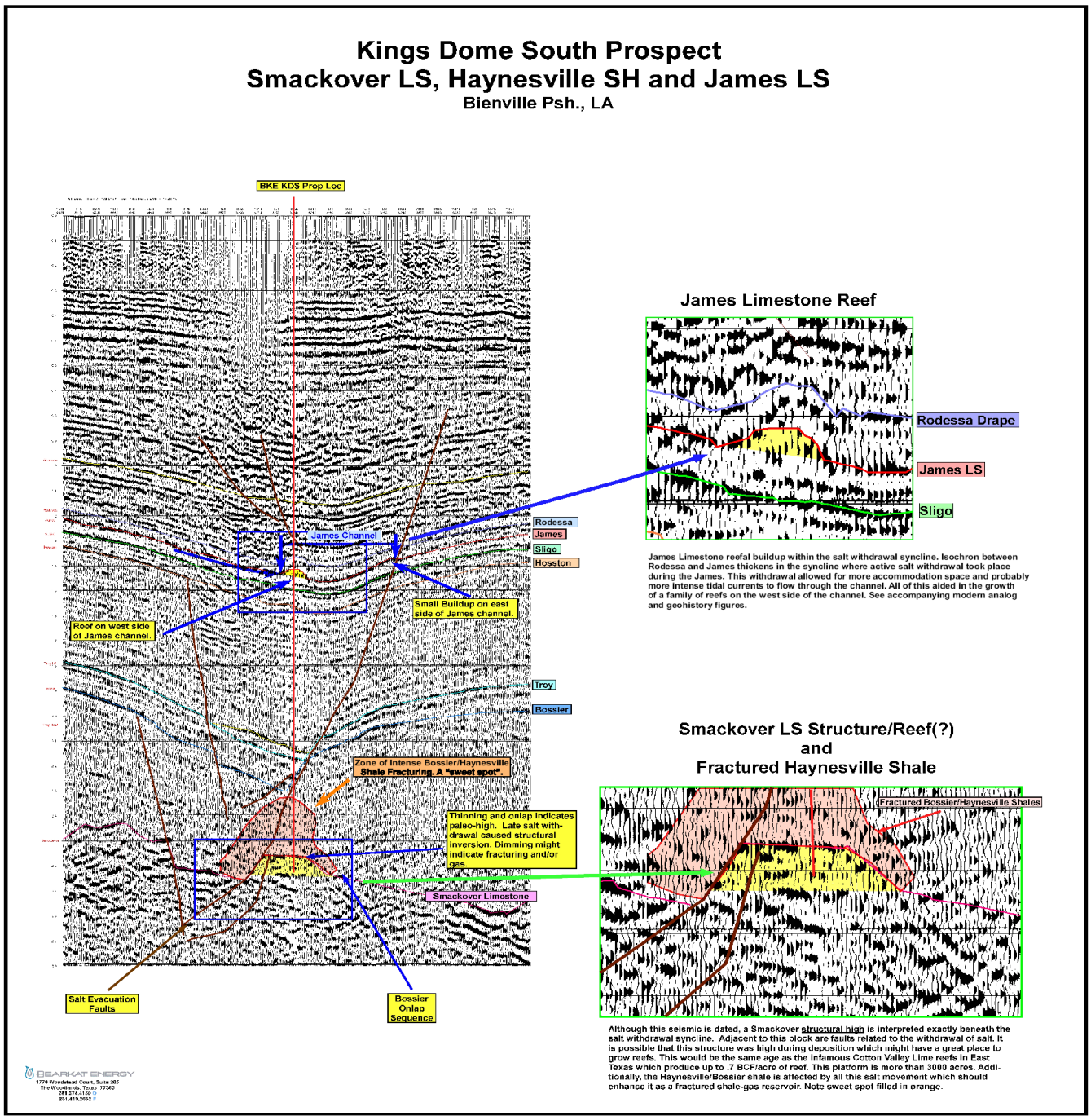

Figure 8. Interpreted seismic line showing the prospective formations – James Reef, fractured Haynesville Shale and Smackover Structure/Reef.

James Lime Prospect

Geology. The two James Limestone reef discoveries adjacent to the King Salt Dome were found using 3D seismic. BKE QC'd this data set (Castor 3D) and confirmed that these were James buildups that are on the flanks of the Salt Dome. It is not unusual to find this geological scenario as is seen in Figure 9 where much larger salt domes than the King Salt Dome are found offshore Abu Dhabi whose tops are occupied by a system of reefs. To grow reefs, there must be just the right conditions regarding water circulation, nutrients, water temperature, subsidence rate and accommodation space. Apparently, salt movement was ongoing during James Lime time which created a moat-like rim of deeper water that surrounded the dome at this time. This provided an invitation for fresh seawater circulation with all the advantages stated above. Subterranean salt movement also created a salt withdrawal syncline trending both SSW and NNE of the dome as seen in Figure 1. These withdrawal areas can be easily mapped at different horizons in many of the East Texas salt domes. (see Senni and Jackson's work the last 25 years). It is clear from regional mapping by GEOMAP and the isochron work done herein that withdrawing salt created a linear, deeper waterway or channel in this area. By doing so, suitable conditions were present to sustain reef and/or shoal development dominantly on one side of the paleo-channel. This scenario is plainly seen today in the Great Barrier Reef of Australia in Figure 9. The analog is nearly perfect in that the carbonate buildups are much larger on one side of the channel. The seismic line over this prospect shows this as well where the western buildup is much larger than the eastern buildup as seen in Figure 8 and mapped on Figure 10. It should be remembered that this part of the James Lime shelf was lagoonal and dominated by shallow water lime mud deposition which subsequently developed into mostly dense limestones and marls. In special situations, mostly related to subsurface salt movement, the James deposition system supported reefing and shoaling environments. Most notable is Fairway Field just to the east in Texas that will produce more than 200 MMBO. Most of the other production in the James is from relatively tight shoal deposits. These have been commonly drilled horizontally in Texas and Louisiana as a "tight gas reservoir". We expect better production from this prospect since it proximal to the excellent production at King's Dome. There could be two pods or even a daisy chain of these reefs that formed along this salt withdrawal feature. This can be seen in the EMT work on Figures 6 and 9. The prospect is focused on the southernmost reef identified (Figure 11) which showed the best quality and thickest reservoir on the EMT data.

Seismic. Only one line was purchased to verify EMT data. The James buildup found on Shell line 79-114-415 is clearly seen at the James level. Additionally, a series of isochrons were calculated on several horizons – each involving the James as one member of each pair. It is clearly seen in the values, colors and the interpreted seismic that there was a thickening in this interval during this time caused by salt withdrawal. This confirms the ideas stated above about this area being suitable for reef and shoal development with deeper water, higher wave action, better circulation, etc.

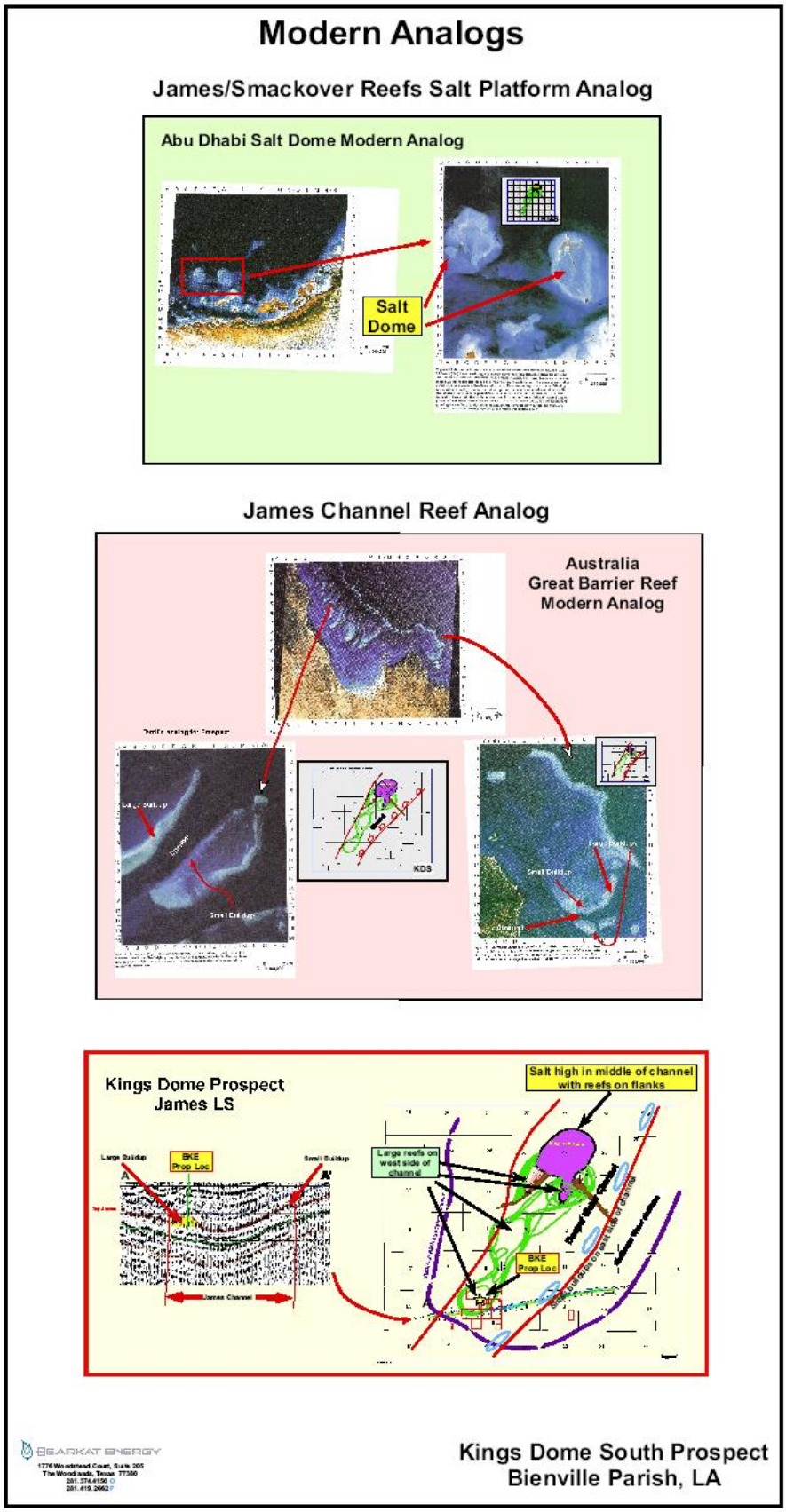

Figure 9. Modern analogs for both the James and Haynesville lime Prospects. All maps to scale.

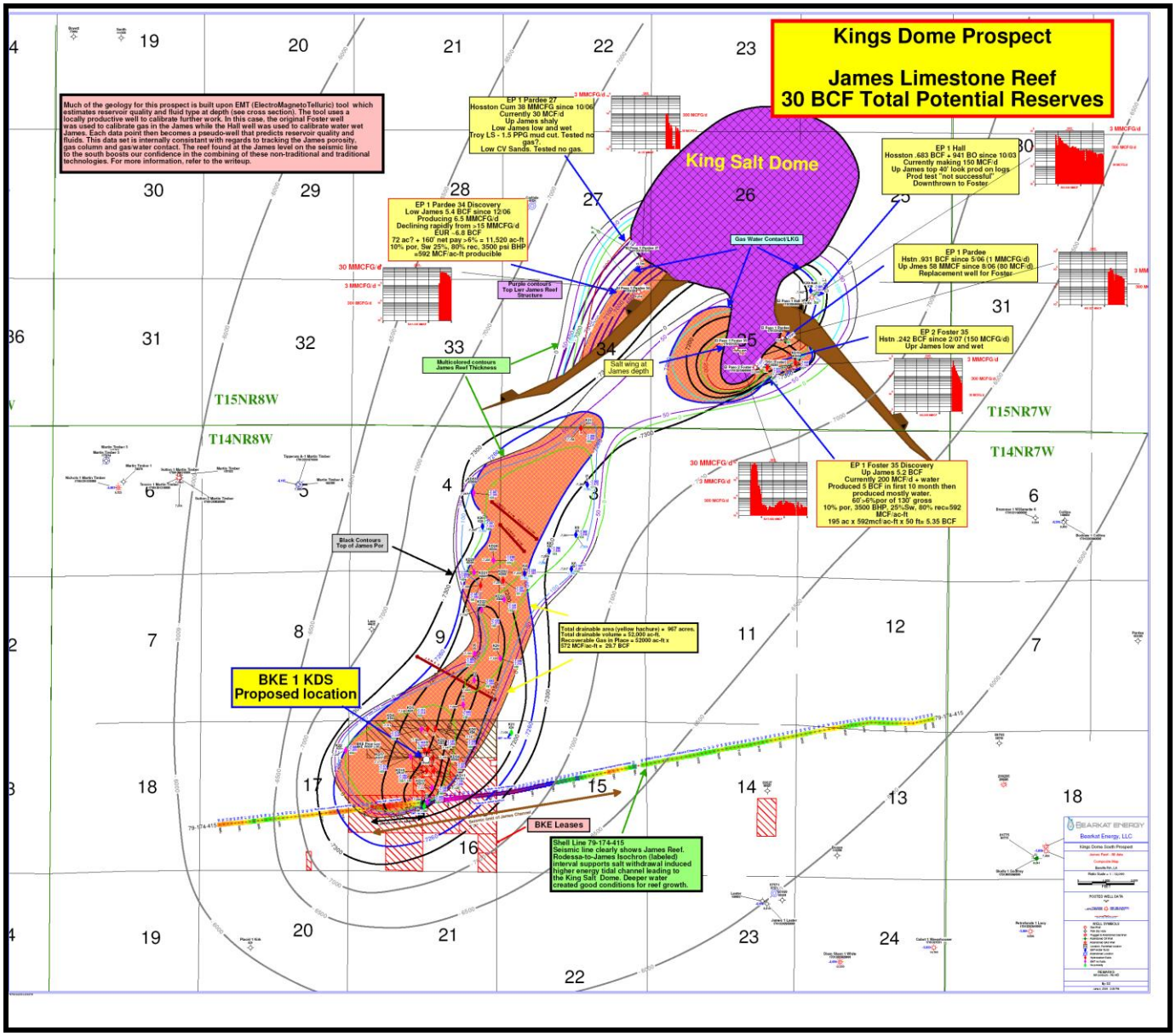

Figure 10. James Lime combination map. A complicated map. Black contours define the top of James porosity structure derived from the EMT data. The multicolored contours describe the reef thickness – also from the EMT data. All data sets match coherently.

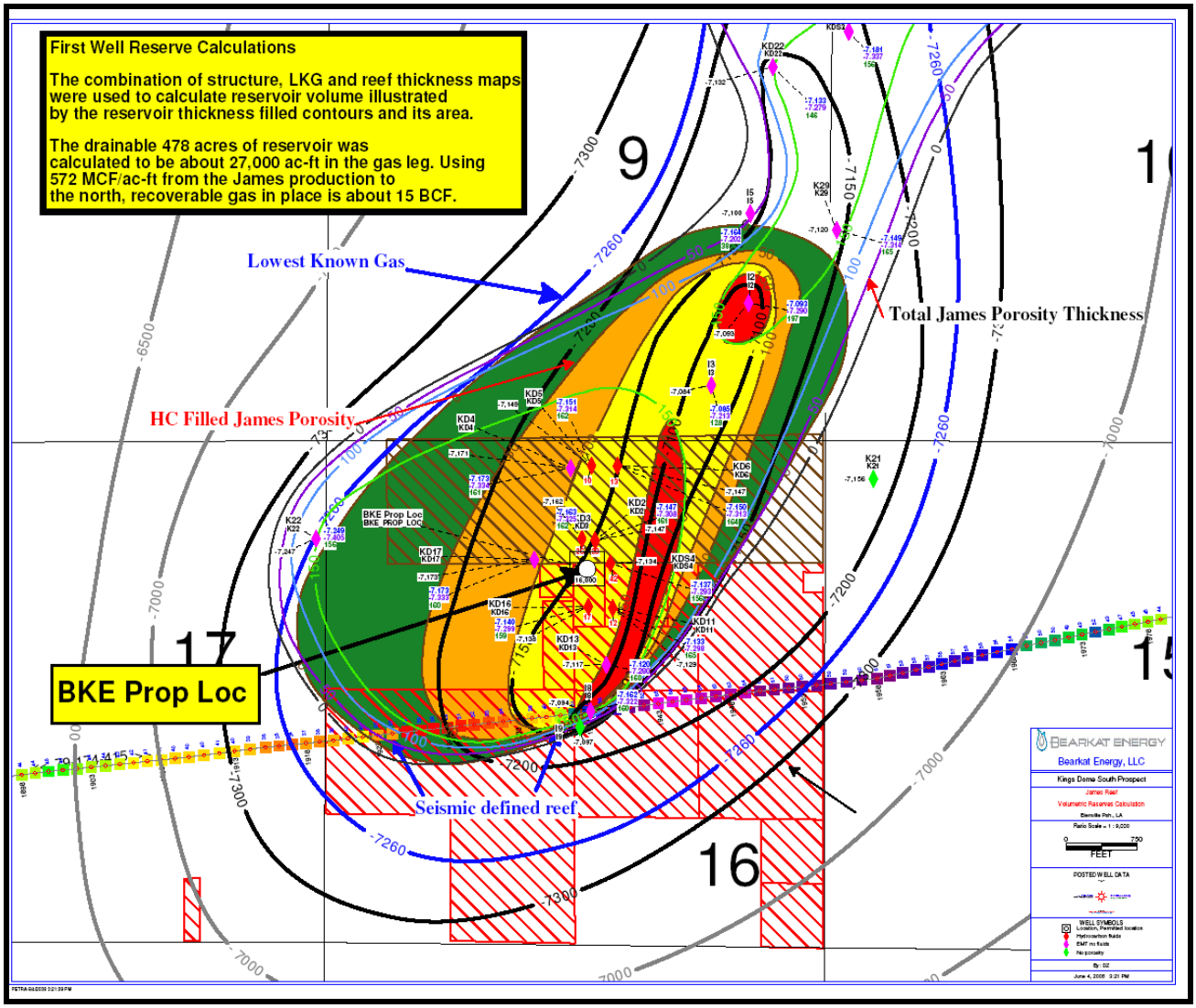

Figure 11. Detailed map of proposed location with expected drainage from this borehole.

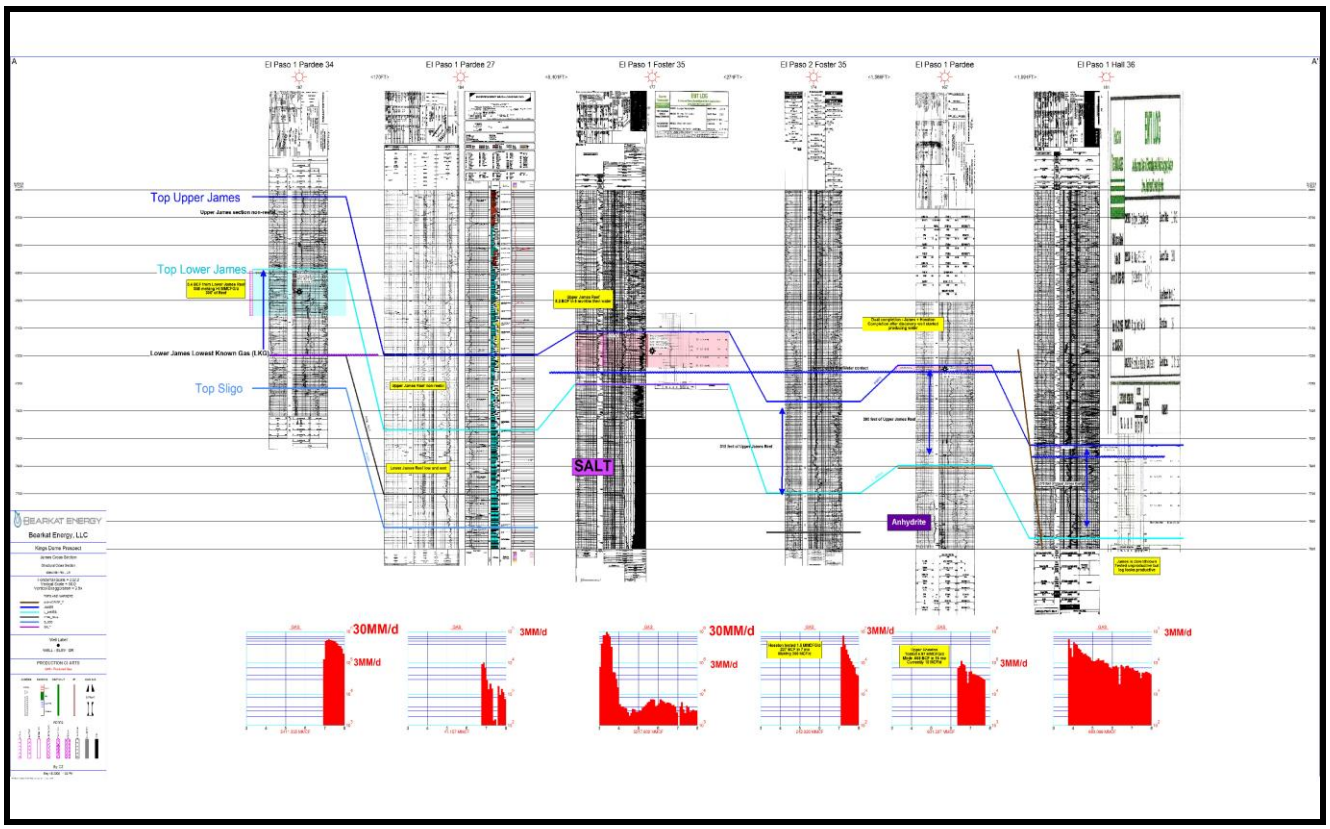

Figure 12. James Lime cross section with production curves. Note that the James production is from two separate reef horizons within the James.

Technology Discussion

This prospect is unusual by industry standards in that it was developed using tools which were designed specifically to find hydrocarbons. The ElectroMagnetoTelluric (EMT) tool uses naturally occurring earth currents and derives a resistivity profile of the earth. It has the ability to measure tops accurately and define thickness, quality and fluid types of a reservoir.

EMT Technology. The EMT technology is a passive telluric method that has been around since the 1970's (PetroSonde). It continues to improve with time. It should be noted that these "new" EM tools are becoming critical to many major company exploration tool boxes. Since hydrocarbons create large resistivity anomalies in the subsurface, isn't it logical to use tools that can discern resistivity changes? Standard industry exploration workflow relies almost exclusively on acoustical tools like seismic that cannot "see" resistivity. In particular, Shell and Exxon are using EM tools like these in the offshore subsalt arena where the price for failure (and success) are extremely high. With this tool, telluric EM waves that originate from the energy provided by either lightning strikes and/or from solar winds are collected and manipulated in order to sound for changes in signal character versus depth. Local reservoir calibration is necessary. Once calibrated, like signals are searched for in the signal stream of the selected sites. Relative reservoir quality, thickness, and fluids can be derived. In this case, the EMT data were calibrated for gas at the discovery location (Foster) and for water at the Hall location. Note each of these sites were occupied several times. Each point then becomes a pseudo-well that can be used to map reservoir quality throughout the prospect area. The interpreted signal describes relative porosity part and fluid signal strength. These two aspects are combined to give a relative productivity estimate. Numbers 5 or less are sub-commercial. Six is commercial. Seven is considered very good

reservoir. More than 7 are terrific very high permeability reservoirs. These evaluations are somewhat subjective. However, the body of work here is very robust and internally consistent to the extreme. A high level of confidence is present because of the redundancy and consistency as seen in Figure 13. The EMT data were not used on the Smackover or Haynesville as this idea came very recently.

Figure 13. James Lime EMT cross section with calibration logs.

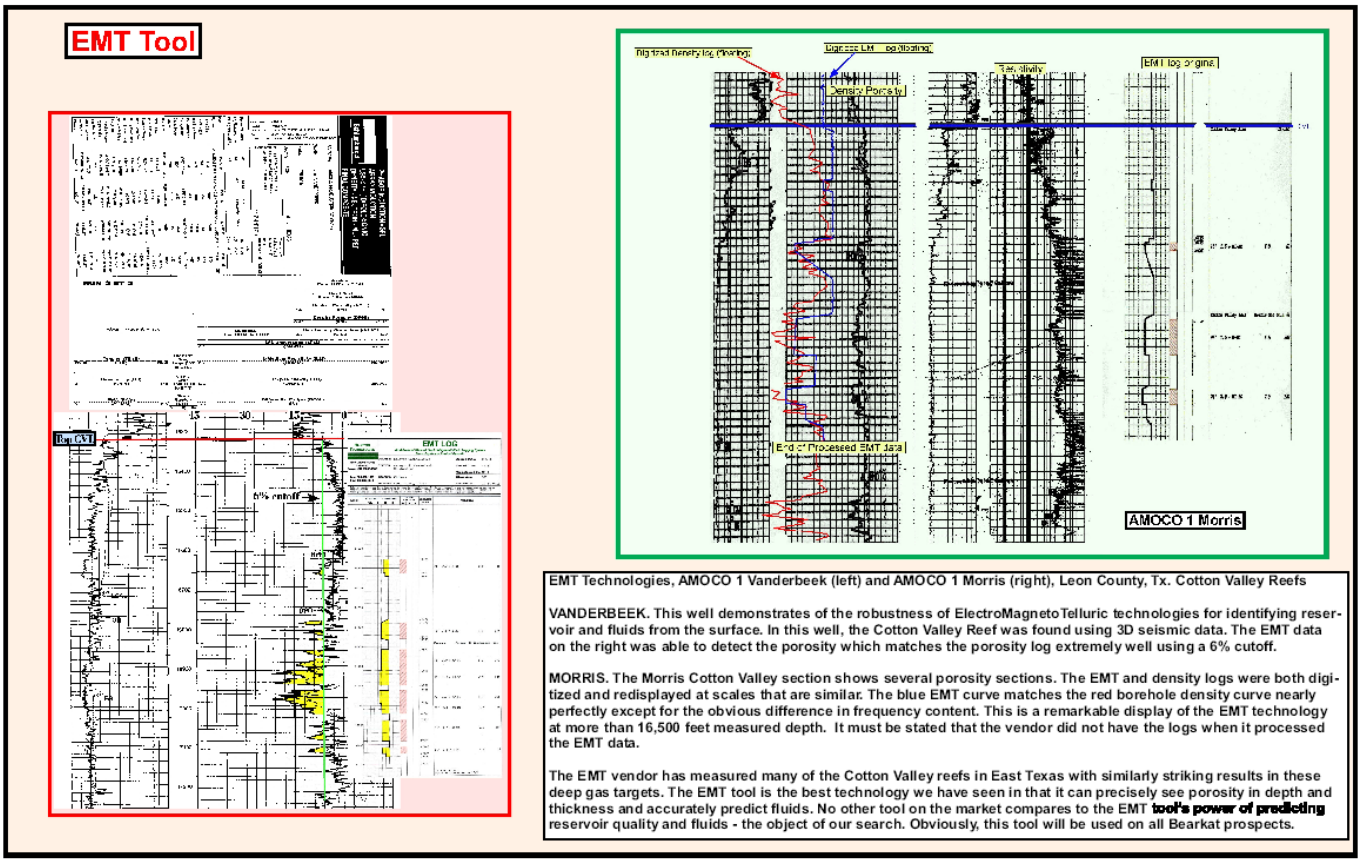

Figure 14. Examples of EMT on Deep Cotton Valley Reefs in East Texas..

Reserves and Economics – James only

The reservoir character found at King's Dome Field was used to calculate the reserves for this prospect – 572 MCF/ac-ft. Figure 10 contains the calculated reserves based on the thickness of reef above the Lowest Known Gas (-7260) . The entire reef is nearly 1000 acres, contains 52,000 ac-ft of reservoir volume and contains nearly 30 BCF of producible gas. Since we only have the southern portion of the reef leased, the calculation for 478 acres (Figure 11) is 27,000 ac-ft of reservoir, and 15 BCF of producible gas. This assumes the reservoir character for the entire section of reef is the same as the producing wells to the north. Conservatively, if we just estimate 20 net feet of pay over the 478 acres,

then we can expect 5.4 BCF of gas. However, it should be observed that, where the EMT data identifies reservoir porosity but no fluids, it is likely a tighter reservoir but still can contribute to total reservoir volumes. For instance, at the proposed location EMT point (KDS4) has 156 total reservoir thickness of which at least 121 feet are above the lowest known gas (LKG). The EMT survey was able to identify 42 feet of fluid which is gas. The remainder of the reservoir (121-42=79') has porosity and should contribute to the production. So, the 5.4 BCF is a conservative estimate of producible gas.

Dry Hole costs are estimated at $1.6MM. Completion costs are estimated at $240K and pipeline/facilities at $771K. Total drilling, completion and facilities costs are $2.8MM. With 75%NRI, 20%carried to the tanks, initial production at 4MMCFG/d, EUR 5.1 BCF and 25% annual decline rate, the Return on Investment calculates to be 7.2:1 and payout in 7 months for the first well. NPV 10 equals $15.4MM. $9 gas was used escalating 3%/yr.

Reserves and economics – Smackover only

If we use the Cotton Valley Reefs as a reservoir model, then the reservoir will be highly geopressured and have a tremendous thickness of porous rock. Should the reservoir character be similar, then we expect between 3 and 30 MMCFG/d and 5 to 50 BCF/well. Obviously, at today's prices, the entire range of possibilities works. Dry hole cost is $6.8MM: completion cost is $1.8MM. The 3MMCFG/d 5BCF/well scenario produces ROI of 2.7, payout of 28 months and a NPV10 of $7.2MM. The 30MMCFG/d 50BCF/well scenario produces ROI of 27.7, payout in 3 months and NPV10 of $153MM. Economics do not include cost of pipeline. There may be enough land for 2 wells.

Reserves and economics – Haynesville Shale only

The low case economic model for the Smackover can be used for the Haynesville Shale. Dry hole costs are approximately $6MM with completion costs at $1.6MM for a vertical hole. A horizontal extension will be an additional $2.5MM.

Additional opportunity

Hosston/CV Sands Formation. The Hosston is producing from several wells that El Paso drilled at Kings Dome. Only one of the wells may make more than 1.5 BCF, There is nothing on the seismic that compels us to drill for the Hosston alone. Other operators are drilling horizontal extensions into both formations and making commercial completions.

Land

IE currently has 306 acres under lease with an additional 150 acres pending. The lease position can be expanded considerably to explore for more James reefs or extend the Smackover idea.

Follow up:

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