

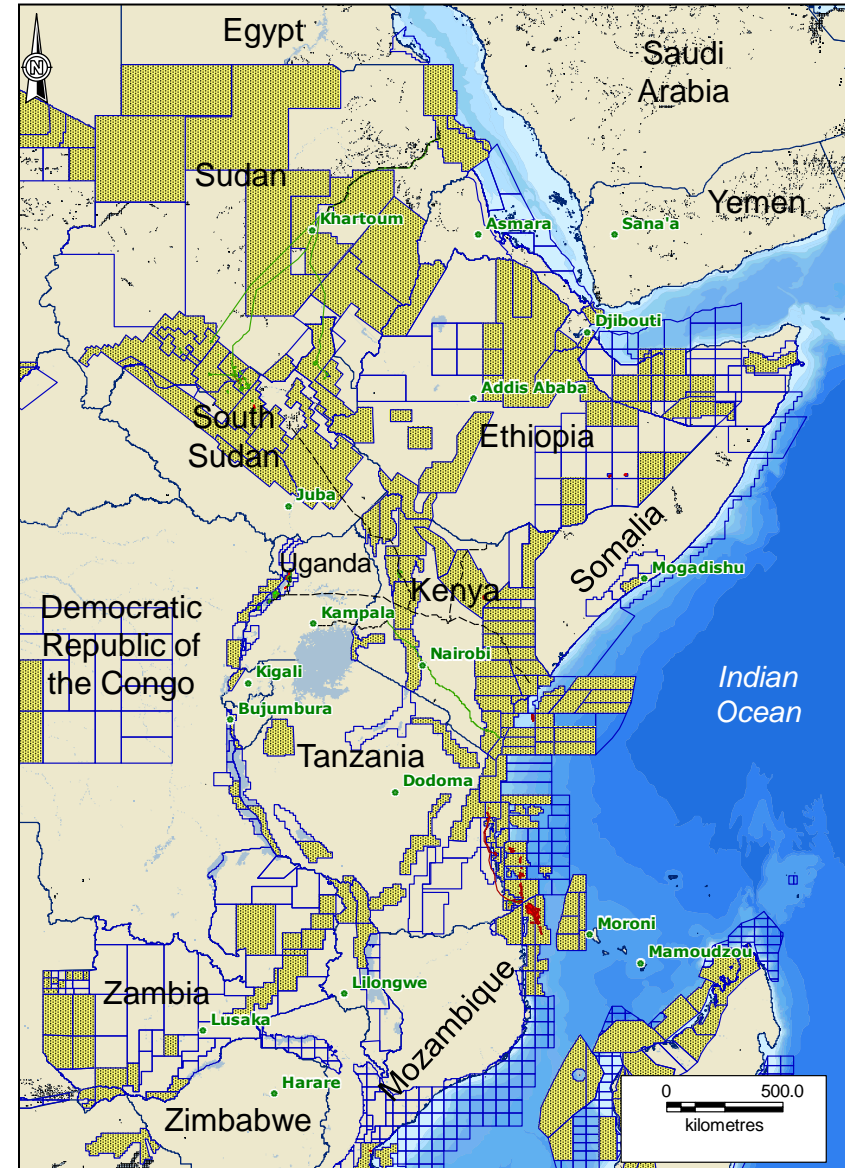
East Africa – Disputes, Pipelines and Wax

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Overview

- Tullow/AOC - 4th discovery in Kenya. Overall EUR of >400 MMbbl.
- Uganda – refinery and pipeline plans progressing. Significant volumes EUR ~2.5Bn Bbl.
- South Sudan – significant oil volumes (3.5 Bn Bbls) but problematic relations, looking for Southern export route.
- Ethiopia - reports of 2 to 3 Bn bbls EUR but no production today. Also gas.
- Tanzania - gas discoveries - 25 PSA signed - BG, Ophir, Statoil and XOM. ~>50 TCF GIIP.
- Mozambique - Rovuma Basin - Anardarko and ENI. Overall ~ 150-200 TCF GIIP



East Africa Latest

- Uganda – Upstream
 - Landlocked.
 - About to license >dozen new blocks – end 2014 licensing round.
 - 8 yrs since last round – moratorium to allow time to develop fiscal regime.
 - Quoted “reserves” of 3.5 Bn Bbl (but only ~50% “recoverable”!!!). More likely EUR of 2- 2.5 Bn Bbl.
 - 76 out of 88 recent wells encountered oil.
 - Three main players – CNOOC, Tullow and Total.
 - Production levels could be 200 kbpd over 3 decades.

East Africa Latest

- Uganda - Downstream
 - 4 companies shortlisted to build new refinery (60kbpd) – likely start-up in 2018.
 - Mombasa to Eldoret products pipeline in Kenya currently provides product to Uganda (35 yrs/old). Possible pipeline expansion to Uganda and Rwanda. New Twin line also considered (\$500mm).
 - Problems with this line caused recent price hikes in Uganda.
 - Consumption is about 20 kbpd products.
 - Proposed pipeline from Hoima to Lamu – 1400km; ~\$4Bn – largest heated pipeline in the world.

Uganda Oil Refinery

- 260 km northwest of Kampala.
- National policy dictated refinery solution as part of national development. Build-Operate contract.
- \$2.5 Bn price tag.
- Near Hoima, close to DRC and Lake Albert oil fields.
- On-stream 2018 (?). 1st production license CNOOC- Kingfisher field in late 2013.
- Nominal 60 kbpd (2x30 kbpd trains, second train 2020).
- Includes pipeline to Kampala, storage facilities, road, hospitals etc.
- April 2013 – agreement between Govt and CNOOC/Tullow/Total to build refinery and pipeline.
- June 2014 – proposals submitted – 4 bidders.

East Africa Latest

- Kenya – Upstream
 - 4 sedimentary basins including offshore.
 - Tullow/AOC to present FDP for South Lokichar in 2015.
 - Volumes of 600 MMbbl and are commercial (Reuters).
 - Start-up – 2018, possible pilot production in 2016.
 - Crude is waxy, with pour point >40 Deg C, like in Uganda.
 - Moved to license open tendering recently and introduced PSC models for discoveries.

East Africa Latest

- Kenya - Downstream
 - Only regional refinery at Mombasa; 80 kbpd but operates significantly less capacity (~35 kbpd). Refinery designed for heavier, sour Abu Dhabian crudes.
 - Consumption is about ~80 kbpd petroleum products. Imports make up rest.
 - Proposed pipeline Uganda to Lokichar ties in to South Sudan pipeline to Lokichar, then Lokichar to Lamu port. Maybe added to LAPSSET.
 - Lamu Port Southern Sudan Ethiopia Transport (LAPSSET) project includes pipelines, new refinery near Lamu, railway, airports, new roads.

East Africa Latest

- South Sudan
 - Landlocked.
 - Reserves of 3.5 Bn bbls (BP Stats) mostly in Muglad and Melut basins. Waxy crudes. Significant gas but mostly flared.
 - Much civil strife – only recently has peace broken out again.
 - Current production – about 160 kbpd – pipeline through Sudan – history of animosity and pipeline closures.
 - Possibly future production of ~400 kbpd.
 - All petroleum products historically imported.
 - Small new refinery – 3 kbpd Unity, expansion to 5 kbpd of diesel with Russian investment.
 - Second new refinery (Upper Nile) being built -10 kbpd.
 - Proposed southbound pipeline.

Options for Sweet Waxy Crude

- Waxy crude with pour point -
>40 Deg C.
- Solidification will block pipeline.
- Heated pipeline solution
 - Heating stations to heat crude
 - Electric trace – expensive and requires electrical generation
 - Pipe in pipe – expensive – still need to generated heated fluid (water) to pump through annulus.
- If flow stops or slows (heat dissipates before reheating) then potential blockage.
- There is always a risk of blockages – need to consider pigging and pigging stations.

Options for Sweet Waxy Crude

- Chemical suppressants to reduce pour point – expensive and science not well understood. Also reported concerns with corrosion rates etc.
- Or remove wax from oil and pump oil in “normal” pipeline (normally carried out in refinery)
 - Solvent extraction oil mixed with solvent (e.g MEK), chilled, separated, solvent recycled.
 - Propane solvent dewaxing.
 - Membranes? Unproven.
 - Catalytic dewaxing – selective hydrocracking or isomerisation of long-chain paraffin molecules.

Waxy Crude – If you asked me....

- Possible to combine crude dewaxing facility at proposed Hoima oil refinery. Quadruple capacity vs standalone dewaxing for refinery.
- Crack or isomerise wax to refined products in refinery – generally produce good blendstock for gasoline/distillates.
- Dewaxed oil could be transported to coast through normal pipeline saving millions in CAPEX and OPEX.
- Still requires oil well to refinery solution – diluent/ pour point suppressant.
- Issue here: all players are E&P focussed – no integrated company to lead upstream-midstream-downstream optimisation.

Summary

- East Africa contains significant recoverable oil volumes and there is also gas
- Usual problem persist with bilateral relations as well as Govt to Oilco relations
- There is progress on regional infrastructure with a likely oil pipeline system possibly 3-5 years away.
- Uganda, Kenya, South Sudan and possibly Rwanda and Ethiopia are potential stakeholders.
- Crudes throughout the region are excellent quality with a potential market in Asia but contain significant wax content.
- Wax is a problem due to high pour point and must be considered optimally.
- Solutions to date promoted by upstream or downstream, no-one is thinking integrated yet.
- Given the nascent position, the potential throughout East Africa for oil is strong but the midstream and downstream will be important.

Thank You.

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