

# 15 September 2021 - James Granath Presentation

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## SPEAKERS

Jim Granath, Moderator, Helen

### **Moderator** 01:35

Okay, folks. So welcome to the fourth talk in this session. So I won't spend too much time introducing, but just welcome to Jim Granath. who's who's dialing in from the States, I think, Jim? Jim is from Denver, Colorado so Jim is a gardener. I'm in dark London. so Jim is a consulting structural geologist based in Denver, has been for some time, and today's presentation is very exciting. So we're looking forward to some of the results from the recent wells. Jim's talk is on the Kavango basin, onshore Namibia, going to give us a run through the exploration activities in recent times. I'll hand over to you, Jim, thank you so much.

### **Jim Granath** 03:59

Thanks, Brian. And hello to everybody, wherever you are. I'm going to speak for the 20 minutes on what's been happening with recon Africa's exploration project that I'm speaking on, kind of on behalf of a committee. You'll see we've added Dan Jarvie to the to the author list because we've included some of his work on the hydrocarbons. So as many of you may know, recon Africa licensed pel 73 in northeast Namibia, a number of years ago partly on the play concept than the Karoo basin system connected by lineaments, acting as shears in the basement, transfer faults in the basement, continues all the way across the continent. This is an idea or proposal that Bill Dicks and I have been doing for a number of years largely in this forum. So they picked up that set of blocks converted into a Pel 73 and have tested the play concept. The idea was that what we used as the Kavango basin is separate from the Owambo Basin for a number of reasons. And then it's tracking in the pan African fold belts, and particularly the lineaments that are related to the structure within those pan African fold and thrust belts, and their metamorphic cores. Bill and I nicknamed this the Southern Transafrica Rift and Shear system or STARSS. And so the activity in 2021, by recon has been meant to test the basic idea, this play concept because there were no subsurface or even surface geologic information to really validate based entirely on potential method data sets. So today, I can talk about one Well, we've drilled two, but one well is available for public consumption, the other hasn't been released by NamCor yet. We'll talk about some of the work that's been done to establish the reservoir quality in the hydrocarbons

characterize the hydrocarbons. And I'll be speaking for other people in these sorts of things. These are not along my specialty. But then we'll turn to the impact of this activity on the concepts that went into this play, and the impact on the regional stratigraphy, structure and tectonics. And finally, what what the difference between the Owambo and Kavango basins are. And then finally, I'll mention the geophysical program, we've started to collect seismic data. So 2021 operations actually started in 2020, with the beginning of the drilling of a number of water wells, largely to support the two wells, two wells were drilled to do those. And then a number have been drilled, I think seven, probably by now, as community water wells, the first one is typical of them all. And it was sort of amazing and quite, quite enheartening that we got 7000 cubic meters per hour of absolutely fresh water out of the top of the Karoo group out of the Etjo sandstone. People familiar with North America would probably recognize the Etjo because it's almost a dead ringer for the Navajo sandstone in the western United States. And it's an Aeolian, lower Jurassic, sandstone, roughly a 100 meters thick or so. So that started us out then starting in January, we drilled two stratigraphic test wells, using an innovative water based mud system that's entirely biodegradable. For ecological reasons. I got to emphasize that these were stratigraphic test wells, they were not Wildcats drilled on prospects, because we did not have any prospects. They were intended entirely to get an idea of the stratigraphic content of the basins and also if there were any hydrocarbons present. So there's been a lot of confusion in the public media about that. As a result of them being stratigraphic test wells. Drill stem testing was not part of the well plan. It was not permitted by Namcor. And so we don't have any drill stem test yet. The wells were left suspended so that they can be re entered in those drills that test done later. And a couple of months ago, a couple of weeks ago, really, about a month ago, we started a 450 kilometer 2D seismic program using Polaris out of Canada, and an accelerated weight drop system, again for ecological reasons with cableless recording using strike nodes. So the survey, although we're still fiddling with the best configuration, is getting us 200 or more fold on about a 12 kilometer split spread. And with testing, we reduced the spacing of the sources and the receivers that we could get good signal. We are having noise problems. About half of that is done, unfortunately I can't show you any results yet but I will comment on them later. So first a little bit about the wells, actually about the 6-2 well, 6-2 was a location picked years ago by a number of us and it has since floated to the surface as the best first strat test and it's acquired the name Kawe. So in this slide, we've got a lithologic column, sort of a generalized poro perm column to parallel it, then we've got some hydrocarbon data mostly based on gas from from Dan Jarvie's Worldwide Geochemistry group, and an FMI representation that was done in the carbonates at the bottom of the well. So what we got was about 200 meters of Kalahari and Cretaceous basalt sitting on top of that Etjo sandstone, that's the source of the water, the aquifer. And then in 6-2, there's about 800 meters of Karoo, starting in clastic, mostly terrestrial red beds growing down into grey colored clastics. With a number of pretty good horizons in terms of Poro/perm, of course, the Etjo sandstone in that water production is obvious. The bottom of the section there's another sandstone that is similarly excellent in reservoir quality, and then are a number of other intervals that are probably reasonable in terms of their reservoir quality. Below that, we went through an unconformity and into some carbonates that we think are probably pre Karoo Paleozoic, and then finally into some carbonates at the bottom of the well, the bottom half of the well that are really badly deformed and steeply dipping, we think those are related to the frontal fold thrust belt on the Damaran Orogeny to the basement. So there are a number of possible intervals for reservoir quality Etjo itself, of course, it's too shallow to be of much use where it is right now in this particular location, but then two horizons in the Karoo, and then two horizons in the carbonates down below. In the hydrocarbon chart, we've got the position of the shows, we've got some

gas ratios, various plots of the gas ratio C2 over C1 plus C2, and then I think Dan calls that oil potential. And then his production index and its oil saturation index. And collectively, they suggest that below about 700 meters or so here, just just below him just above 700 meters depth, we've got what looks like a gas and oil column. Again, opposite a decent reservoir, we've got some reservoir data, which I'll go into, his production [projection?] indicates it's migrated petroleum, and then it's potentially producible. And that's repeated in several horizons with the top of the carbonate section and then deeper in the carbonate section. This one I think we thought was going to drop out as being a candidate, but some of the laboratory data brought it back into contention. What we need to emphasize is that this isn't the be all and end all. This is based on cuttings above this, this little blue line as well as gas chromatograph and shows. And below that it's based on some plugs that were taken in the carbonates, the carbonates were drilled with the PDC bit and so they came out as literally ground up sand, we had to depend on what was in the in the sidewall cores, to get any information. So there's a little bit of difference in the samples above and below the top of the carbonate section. The important point is that of course they're all thermogenic hydrocarbons and they're migrated petroleum we did not encounter a source rock Okay, we look at the reservoir potential the important things in this chart which is data provided to us by Netherlands and Sewell. This is a composite out of one of their reports, their reservoir quality is based on the Sneider criteria, which they show in the box to the lower right here. So these potential levels of reservoir are pretty sizable: 50 to a 100 meters in some cases. And in a lot of cases they're excellent porosity, 20% or so, but in this particular place, they have a high water cut. But down in the carbonates the porosity is much lower. This is matrix porosity, but as we'll see in the FMI data, they're highly fractured. So, so this porosity is fracture-assisted. And then in terms of the rotary sidewall analysis, permeabilities are pretty good too up in the carbonates. These are all from the carbonates and the cores, the sidewall cores. Three levels in the carbonates, the top two at 1355 and 1890 had shows when they gave us permeability, air permeability as you can see here in terms of millidarcys. Those are matrix, again, those are matrix readings. And we have to emphasize that their fractures going to be fracture of system, which is not counted in this chart. So then if we look at the stratigraphic implications of the area, we've kind of put on a chart here of four locations where Karoo is occurring. The two wells are in this location here, in the Owambo Basin to the west of the ST1 well, which is a number of years old. It's another subsurface occurrence. And then down in the Waterberg. There are two near surface shallow coal exploration wells and head (in the) Karoo and finally, the Waterberg national park at outcrop. And the Kavango Basin wells fit right in. The one thing that's different about them is that at least at 6-2 we didn't, we didn't really encounter any glacial Karoo at the base of the section like ST1 and some of the other locations have. The total section of Karoo is a little bit thicker. It's comparable to the Waterberg National Park outcrop area. And of course, if you only have a 200 meter well, you're not going to get much of a section. But we had the lower part of the Karoo, and with a little bit of luck in the shallow coal wells. Down in the Waterberg both of those are sitting on crystalline basement, which is the core of the Damara orogenic belt projecting to the east and then at Kavango and at Owambo, they're sitting in what used to be called the Owambo basin, but at Kavango, they sit on Paleozoic carbonates, and then there's folded Mulden and probably Otavi carbonates, they're basically, I'll show you, related to the fold belt and the front of, from a part of the Damara Orogen. Whereas the Owambo basin is sitting above a Siluro Devonian Paleozoic section, which we which we picked up in our paleontological review of that particular well. And that is sitting on top of a stratiform section in the Foreland Basin to the orogenic belt. All of that to the north sits on basement which is faulted in the Katangan extensional system and in Proterozoic time. So the wells fit right in and they tend to suggest

that there is something more than the typical, the typical Karoo in the Owambo Basin. So as far as structural results from the well, here's a downhole plot out of Lithotec of the FMI data here projected into a plane perpendicular to the fold axis that's defined by that data. So the banding from the Schlumberger FMI is shown here in this [theory in diagram] a nice girdle forming, indicating a southeasterly plunging fold axis. So we think that down in the carbonates, we've drilled into that Neoproterozoic fold section, with perhaps a little bit of Paleozoic carbonate sitting on top of that, and then Karoo, 800 meters of Karoo below the Kalahari. And it's dropped about a kilometer below that same section, or the folded section and the carbonates has dropped about a kilometer below the same section and outcrop to the southwest. So the conclusion from the structural data is that we drilled into highs within the STARS blocks, the top of the block, we did not get into the Graben, as I thought in some of my earlier models turned out to be grossly in error in their estimation of the thickness of the Karoo. And that at the base of the well we've drilled into the fold belt of the pre Karoo sedimentary rocks. So if we put that in the regional perspective, here's the northern half of the geologic map of the country and I highlighted with the thrust belt symbol here, the frontal part of the Damara Orogenic belt where it's a fold and thrust belt with sedimentary rocks is projecting right into the PEL 73 area. If you look at that in the aeromag data, it's pretty difficult to project it but you can take it a little ways, on the base of the aeromag data, this is where the wells are, and then it looks like that fold belt turns to sort of trend Southwest in concordance with the trend and plunge of the folds, and then continues further to the east. As you can see from that illustration, it's pretty hard to pick it. There's a lot of things going on in the aeromag data. One is that there's a cover of basalt. This is a big sill and flow complex in the stippled black area. There are a lot of Karoo dikes in the system and a lot of other features. So it's a little difficult to pick out what's actually going on. So in terms of the regional tectonics, the difference between the Owambo and the Kavango Basins basically boils down to the fact that the Owambo Basin is a stratiform foreland Basin section related to that orogenic belt. Damara orogenic belt. This is basement in pink and the fold and thrust belt right in front of it, it continues into the northeastern Pel 73 area. So the Owambo sits in front of that. In the MARIMBA data from [inaudible]. This is primarily based on gravity as well as some other information. This is purported to show sedimentary thickness so it represents the cover and the Owambo is a thick section, which is reduced a little bit, I think, because of the density that's involved in the carbonates and the basement rocks that are in the bottom of that basin. If we look at the far eastern end of the Owambo basin, there is a seismic line that's available, it's the closest one to the PEL 73 data, and it shows that stratiform section, sitting on top of an unconformity above the [containment] rifts and the fault blocks of [crystalline] basement. So on the original Earthfield technology inversion, or Werner deconvolution, you can see the Kavango is sort of indistinguishable in terms of its depth the basement. That's because it's picking up on the depth to the crystalline basement which is underneath that fold and thrust belt. So if we compare a section in the Owambo Basin, with the stratiform section going down to the unconformity of both basement and the contained rift fill, the green surface here is what's being represented in the Owambo Basin at the top of the crystalline basement, whereas the wells have shown that in Kavango there is faulted Permian section above a folded, fold and thrust wedge, the tip of which sneaks out into the center of Kavango. And that that's lying above the crystalline basement again in Kavango that's present. So there's a fundamental difference between those two, two region

**Moderator 22:39**

Jim, that set six minutes to the very end.

**Jim Granath 22:42**

Okay, that's fine. So this is our justification that the Kavango Basin is a real thing. And it's distinctly tectonically different from the Owambo. Word about the seismic acquisition, we're employing modern techniques that sort of resuscitate the old weight drop kind of seismic system, Polaris has an impelled weight drop system. And we are using that with the modern strike cableless receivers. Again, 450 kilometers are permitted. But more is going to be done. I think there's a plan and it's in the process of being permitted. And they've asked us actually to cut some fire breaks that they've given us permission to shoot seismic data along. So that's all coming along, I can't show you any of the data. About half of it, the western half is in the can, so to speak. And it's on the way into processing. And it's meant to image all of these different depocenters in the original model. I have seen some of the field group stacks and I would say that they do show that younger faulted Karoo section. So to some degree, the play is holding up and it's basic fundamentals. So in conclusion, we drilled stratigraphic wells because no on or subsurface geologic data existed. And so these were not Wildcat wells. The objective was detect a petroleum system and to gather stratigraphic data, both of those have been achieved more than we really expected. We didn't expect the shows that we got. We wouldn't say they're discoveries because that word is a little tainted, a little tricky. But in several respects, they do look like they're some kind of an accumulated column, whether they're movable, or what sort of volumes there are is yet to be determined. There's good quality in the clastic and carbonate rocks as far as reservoirs are concerned. So we're now doing seismic imaging to try to get at some of those aspects about the size and the distribution of the structure. And I'd like to acknowledge a lot of the people that were involved in this, particularly Namcor, which is a partner in the project, they've released the information that we've shown you, as well. was people from Pioneer who have been working with us and all the supporting scientists in the service groups that we use, [crona surveys] CoreLabs. Horizon did the mudlogging, Schlumberger for the FMI, Polaris and NSAI have worked on this project along the way. So with that, I'll take any, any questions that anybody may have. I think that pretty much alots our time.

**Moderator 25:28**

Great. Thanks so much. Next question. We have three minutes of questions. So we're okay. The first question I've got here, of course, is on the source rock. So the question is, Do you still believe the postulated Karoo source story? Or do you believe there's a source in the pre Karoo section?

**Jim Granath 25:48**

I think most people associated with recon right now believe that both are there. It looks like there's probably two sources available that have been sourcing these shows. And we say that because the gases tend to suggest that there is a very over-mature source. And it's hard on the basis of the, you know, the depth of any Karoo basins, to postulate that that has gotten [quite mature]. So there have been, for a long time, there have been people who have advocated source rocks within the Precambrian sediments. And there's no reason that that's not true. I personally think that probably there's been some Karoo generation in the bottoms of the of the Grabens that we have yet to prove. But then it's probably migrated into the horst block in between the fault systems

**Moderator 26:46**

So you got some deepwater basin floor shales of Karoo age mixed in with some Neoproterozoic lacustrine type [inaudible]

**Jim Granath 26:56**

Just the other way around, I think the Neoproterozoic stuff would probably be marine, but I mean, I think the most likely depositional environment for the Karoo would be lacustrine. A lot of people have talked about marine incursions in Karoo so that all has yet to be worked out.

**Moderator 27:18**

Okay, so your sidewall cores are, how did you choose the locations of those?

**Jim Granath 27:24**

With the show, as the shows came along. But I think they were distributed all up and down the well column, where we could get them. And the whole idea was that these were primarily science wells.

**Moderator 27:40**

Okay, the next question is, do you take mdts pressure point of sampling in the carbonates on the crew? I think you said you didn't

**Jim Granath 27:50**

Say that again

**Moderator 27:50**

Yes. MDT's. Did you take MDT pressure points or sampling in the carbonates? Or in the Karoo?

**Jim Granath 27:57**

No, there was no indication that there was any overpressure at all. The wells were drilled, overbalanced, because we had no handle on that. But I don't think there was any indication of pressure at all.

**Moderator 28:10**

There's quite a few. Next question was with the data that has been released to date, On what basis was the 100 to 200 or 220 BB expelled hydrocarbons based on?

**Jim Granath 28:23**

I really can't answer that. I think a lot of things have been said, one way or another. And I think a lot of it, it's been, there's been so much. Frankly, I was surprised so much interest in this particular thing. And it's been kicked around a lot for non scientific reasons that, I've heard anything from about eight barrels to 100 barrels being expelled into the wellbore. I really can't say, I think I'd like everybody to know that a lot of what's been said has been driven by short sellers in the stock and naysayers from the scientific point of view. So, and we've been just the we've been the victim of an incredible barrage of hacking attacks and all of our computer systems.

**Moderator 29:17**

O Gosh. There's been, there's quite a few more questions on the source rock. Let me just ask you one more, Jim. And you touched on it, but can you explain in more detail the missing Mulden, in terms of non deposited or being eroded.. Have you hit the realizing bend?

**Helen 29:35**

Sorry, that was me, "releasing bend", sorry, Jim, that was..

**Moderator 29:38**

The releasing bend, There you go.

**Jim Granath 29:44**

Is that Helen?

**Helen 29:46**

Yeah

**Jim Granath 29:47**

Helen and I have talked about this before. My concept of all of these basins over in the western side of STARS is that they are extensional basins between the lineaments acting as strikes-slip and transfer faults, so they behave like pull aparts. And I think no, we just don't have enough seismic information to really put together a good tectonic element at that level within the basin, Helen. We're hoping that will come out of the seismic program.

**Moderator 30:22**

Great, thanks Jim, there's loads of linked questions to your seismic survey, and how you hope to delineate the structure. But we're two minutes over just eight or nine questions for you to look at after the q&a. But just like to say thank you very much for your presentation. Fascinating

**Jim Granath 30:35**

Yeah, is there a way that I can answer those

**Helen 30:38**

Yeah, on the platform, Jim, and we'd really appreciate if you did, that would be really good

**Moderator 30:42**

Yeah, just rejoin the session again afterwards, and you can see the questions. Thanks, everybody. Thank you. Cheers. Bye.