BOEM DEEPWATER GULF OF MEXICO HISTORY PROJECT

Interviewees: Dave Montague and Mark Shannon

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Place: Houston, Texas

Interviewers: Tyler Priest and Jason Theriot

Ethnographic prefaces: Dave Montague was trained at the Colorado School of Mines in petroleum engineering, but soon moved into petrophysics. Shell soon hired him in that capacity, and by 1984, Montague's career focused on unlocking the geological secrets of the deepwater Gulf of Mexico. As a member of Shell's deepwater exploration group, Montague helped to discover major finds like the Auger, Mars, Ursa, Mensa, and Brutus fields. Tapped in 1988 to work on Shell's interdisciplinary "Turbidite Task Force" (organized to advance the firm's knowledge of turbidite geology), Montague aided in the discovery that deepwater sands could produce oil and natural gas at strikingly high rates.

Mark Shannon began at Shell as a chemical engineer, before being informally drafted by the petrophysics team. His work with Shell took him to California, the Gulf Coast, and beyond. At the beginning of Shell's serious efforts to understand the geology of the Gulf of Mexico beyond the edge of the continental shelf, Shannon was tapped to be one of three co-heads of Shell's internal Turbidite Task Force in 1988. There, he worked with colleagues like Dave Montague and others to decode the geology of the deepwater Gulf of Mexico.

File 1

JT: This is an interview for the MMS Deepwater History Project. We are at Two Shell Plaza in Houston, Texas, on 25 August 2009. We're here with Dave Montague at Shell. Mark Shannon is in the phone with us.

Mark Shannon, Tyler Priest, and Jason Theriot. We're just going to get started with you, Dave. Tell us about where you're from, your engineering background, how you got involved with Shell, then we'll do the same with Mark and then we'll jump into some particulars about the Turbidite Task Force and some other areas.

DM: I went to the Colorado School of Mines to be a physicist and did poorly. Then I transferred to petroleum engineering. In the course of taking petroleum engineering, I ran into a gentleman by the name of Dick Picken [phonetic], who was of the early petrophysical engineer lights within the industry. He got me interested in petrophysics, which was certainly a specialty particular to Shell at that time.

TP: Back to Gus Archie, right?

DM: Yes. I graduated as a petroleum engineer, but you also had reservoir engineers, drillers, electrical engineers and a few petrophysicists. I was hired by Shell as a petrophysicist. Mark's a petrophysicist also, right, Mark?

MS: That's what they claim.

DM: I grew up in the exploration development side of the business, and did a number of things. I guess about 1984 I moved into Deepwater and stayed there until '92, when I then came to Houston, and then moved on to California. So I was involved in fact in the early exploration days. I drilled Auger, Mars, Ursa, Mensa, Brutus, and all of those, and I helped justify Auger to Frank Richardson at the time.

JT: What projects had you worked on prior to that?

DM: Prior to that I worked in the Rocky Mountains, West Texas, sour gas, management positions, just a whole plethora of things.

JT: So was Auger your first offshore project?

DM: No, I had worked offshore in Mobile Bay in the Fairway Field and then dug some certain shallow Gulf of Mexico just a short time before moving to Deepwater.

JT: How about you, Mark? What's your background? Give us a little bit of history on yourself.

MS: I'm a chemical engineer by degree. I started at Shell in California, and in those days everybody started as a production engineer and did field work, and then you were sort of a crop waiting to be harvested into different disciplines. I ended up being harvested into petrophysics, which I haven't regretted. So Dave and I have that similarity in our background and it's not that a common one. I've worked all over the place. I started in California, I've also worked in the Louisiana Gulf Coast.

My background actually is thermal and EOR prior to going to the Research Center. From the Research Center I led a multidisciplinary group. Initially I led the petrophysical research group and then ended up going back to New Orleans to be one of three heads of what we ended up calling the Turbidite Task Force. Then my story changes after that, but I think that's the bit you're interested in.

TP: Were you called to Houston, Dave, in '84, to evaluate Auger?

DM: No. Actually, I was in New Orleans and I got transferred into Deepwater first as a development manager, then an engineering manager. At that time we were responsible for the drilling and evaluation of deepwater well caps. Of course, once we had the discovery, what are you going to do for a development option? Prior to my arrival, I think we had already found and drilled Ram-Powell, which was the first one. Then came Tahoe, Popeye. So there was already a team there that was trying to figure out how we were going to develop those projects. In parallel to that was the additional exploratory drilling effort. So that was probably the three main work streams, wasn't it, Mark?

MS: Yes.

DM: So what you did is, you had a confluence of things that you needed in each of those to understand the deepwater reservoirs and to figure out how to most effectively and efficiently develop them. You can almost go to the back, I think, Mark, to get back to the front. We ultimately ended up saying what we were looking for was high-rate, high-ultimate wells, right?

MS: Correct.

DM: I don't think we used that terminology to start with, but that was the goal, because to build a massive structure like that, you needed a lot of reserves to make things economic, particularly because of the oil and gas prices of that time. So the real guts of it was Shell U.S. Remember at that time we were pretty much isolated from Royal Dutch Shell, and Shell U.S. didn't have much experience with turbidites, and that's what the reservoir in deepwater are; deepwater turbidites. Whenever you try to make a development model and look at the economics, it's not just simply a computer model; it has to be calibrated by analogs and real-world data, and we had very little of that. So basically a Deepwater Task Force was developed and formed to systematically fill the gaps in the knowledge that we had in turbidites.

TP: What knowledge did Shell have in turbidites that led them to acquire those leases in the '83-'85 range? Was it not much or what was it based on?

DM: We had knowledge of sandstones and how to develop onshore and offshore. I don't think, on the face of it, that turbidites are any different than what we had developed before. But there are differences between marine sands, Aeolian sands, and turbidite sands, and they all still have storage capacity, porosity, and permeability. But it's the next level down where you get a little bit concerned. How connected are they? How porous are they? How permeable? And how do they hold up over time, since deepwater is highly unstable?

TP: Were there any clues that these turbidites might be what you were looking for in terms of high-rate, high-ultimate wells and reservoirs?

MS: We were developing a field off Bullwinkle at that time which looked to be a very good reservoir, but in fact, the history of the Gulf of Mexico up to that point was only a handful of wells ever produced above 2,500 barrels a day and we were looking for rates that were considerably higher. The same story can be said on per-well ultimate. The average Gulf of Mexico well was trending upward, but they were only a million or two barrels ultimate, and what we were looking for was ten times that amount. So there was not a lot of direct analog support that said we could do it, but we did have some knowledge and encouragement, I think, from some of the fields we had worked on and also some from the foundation work that had gone into the lease sales themselves.

DM: That's right, and we had a little bit of outcrop work in hand that showed that fairly large, massive turbidite reservoirs could be fairly continuous.

TP: Where were those outcrops?

DM: Ainsa, Spain. I think we had pre-deepwater development, didn't we, Mark?

MS: Yeah. We did northern Norway. There also were some in California.

DM: Some in Newfoundland.

MS: Yeah, there were some in France, and I think South Africa was the other place. We scoured the world.

DM: What Tyler was asking was, what did we have before and what did we have after?

MS: My answer was after, Dave. I'm not sure how much outcrop work had been done, actually. There was a lot of Rufus LeBlanc-type, what you call small-scale simulations of turbidite depositions and sort of the systems work in geology, but that really pre-dates my involvement. I'm not the authority on that work.

DM: No, I think that's right, but I know some outcrop studies had been published within academia. Then you're exactly right, we went out there and did our own.

MS: Yeah, Arnold Bouma was a leading authority on turbidite deposition. [J. D.] Moody and Ricci-Lucchi were another widely read source that was based on Italian outcrops. So there was literature data. I don't know how much of it was directly incorporated into the sale.

TP: USGS did a big study. Was that a little bit later? Was that in the nineties? What was that study that we had?

DM: It was 1980.

TP: USGS did a big study of deepwater where they discussed the turbidites.

DM: Can't answer the question. Have you talked to any of the old Shell exploration people?

TP: Yeah, a lot of them are in the book, Mike Forrest and—

DM: He'd probably be the authority.

TP: —all those. And Billy Flowers, and all those guys we have talked to. But I guess we can move up forward and maybe talk about this task force and when it was created and who were you working with.

DM: I guess it was 1988, Mark?

MS: I believe that's right, about the first of the year.

DM: I went back and tried to find the old files, Mark, and I came up with your semi-annual report in 1/89 to 7/89.

MS: I'm afraid my files are in similar shape. But we began circa January '88. Dave, do you want to tell the story?

DM: I'll try and you can improve. Basically each discipline, in my view, was kind of sifting through the data necessary to try and put a unified theory about turbidites together. The geophysicists were looking at seismic expression, the geologists were looking at facies and continuity, and the reservoir engineers were trying to look at rate and recovery efficiency. It was a small group and we were all working together, but just were not making progress as fast as needed to get on with development. I mean, we had all these discoveries kind of hanging fire, and didn't have enough data to get us over the high-rate, high-ultimate hurdle.

So the Turbidite Task Force was deliberately pulling together geophysicists, petrophysicists, reservoir engineers, and different types of geologists in a coordinated effort to systematically go through the available data, to gather new data, to look at interpretations of existing fields, and to come up with out-of-the-box ways to answer the questions we had. In fact, to leap forward a little bit, we were not only interested in the surface and outcrops or subsurface producing fields; we were interested in near-surface ocean-bottom features. We found—it was Einstein, wasn't it, Mark?

MS: Yeah.

DM: We found un-seismic, right-at-the-ocean-floor features that were very similar to the turbidite depositions we saw at 20,000 feet. But these are at the ocean floor, so it was easy enough to go in there and core or do a sparker survey, so you had like a seismic survey and you could model and link that to surface outcrops.

TP: So these ocean-bottom features, they were in the deepwater Gulf?

DM: Yeah. Einstein was a model for Tahoe, wasn't it, Mark?

MS: Yes.

DM: It looked very similar, the channel levee with the channel through the middle and the splay and very thin beds.

TP: Did you look at any of the coring that had been done back in the sixties, I mean at Eureka or any other deepwater coring? Did that help you at all?

DM: Can't recall doing that.

JT: So you guys did your own coring and used that as research material?

DM: That's right. What we did is we put all these specialists under one umbrella and then attacked various parts of the problem in a coordinated effort. Is that a way to characterize it, Mark?

MS: Yeah, it is, Dave.

TP: Was this at BRC or was it in under exploration?

DM: It was under my group in deepwater in New Orleans. I mean, we drew on people from Bellaire, but it was largely a homegrown bunch.

JT: How many of you all total? Did you say Gary Steffens was involved in that?

MS: Yeah, Gary was one of the original co-leaders.

DM: There were nine people on this. That was probably about the group size, huh, Mark?

MS: I was going to say a dozen, but it's in that ten-to-twelve range.

DM: Something like that. And you said three groups. Those were? Did you have some and Howell had some?

MS: Yeah, at the inaugural meeting of this group, Gary Steffens and John Howell, who was the other co-leader initially, and I met. I was working for Paul Sullivan, I think, but in the organization that was going to become Dave's. Those two guys

came out of Exploration, and they walked in the room and said, "Why won't production mature our prospects?"

Of course I had the perfect rejoinder, which was, "Why can't you find something that's clearly commercial?"

And that's how we began that, because as Dave said, we had these discoveries that were of uncertain net economic value. We really didn't know what they would do. So from that starting point forward, we built this integrated team. One of the more unique things about it at the time was that it was a joint project between Exploration and Production, because it wasn't the style then to work in asset or multidisciplinary teams. We were a very discipline-based organization, I think with a fairly distinct exploration from production function. So it was a pioneering group for us from an organizational construction point of view as well as in the kinds of work we were being asked to do. But as the effort matured, it became more and more clearly aligned under Dave.

DM: Yeah, I think it's helpful to go back to the history of the Deepwater Division. We had the effort in the East Coast that was unsuccessful but then kind of migrated to the Gulf of Mexico, and so it was an untraditional organization, unlike the other producing divisions or exploration divisions within Deepwater. It was a fairly small group of hand-picked people was run first by Gene Voiland first and then by John Krebs, Carl Wickizer, and various Exploration managers. We did a lot of our own thing and were able to do put together projects like the Turbidite Task Force without a lot of corporate overhead, right, Mark?

MS: Absolutely. We jointly reported to Dave and his Exploration counterparts, but we were given an awful lot of license.

DM: And we had people that were really committed to the problem. I mean, they were really interested in understanding the research, the interface between Exploration and Production, trying to make these things commercial, and the work they did really spanned a gamut of things.

I found an old cartoon, Mark, put together by [Gary] Steffens, [J.W.] Kendrick, [Neil] Braunsdorf, Keller, Booth, and Schuh [phonetic] back in 1996, on ultimate-high-rate wells and looking at how do we interpret the seismic facies, what we say about the reservoir architecture and the geologic properties, and what we say about the production systems. We're basically trying to link how the plumbing worked from seismic to the storage.

TP: That had not been done up to that point?

DM: We had done it in conventional reservoirs like marine sands and Aeolian sands, carbonates, etc. It just hadn't been done systematically within deepwater turbidites, at least to our understanding. I made a very clear point of saying we were Shell Oil U.S. and very much isolated from the group. We didn't tell the group much and they didn't tell us much, but I think after some of us woke up in the nineties, right, Mark, we did find out that the group knew a little bit about this in some other areas and we didn't know about it at the time.

MS: Yes, I think that's right.

DM: And also we kind of did ourselves a disservice by keeping a lot of it to ourselves and not allowing the group to capitalize on the technology in other places.

TP: Even after the minority shareholders' buyout, which would have, you think, paved the way for greater integration, there were still these separate cultures, separate organizations.

DM: That's correct.

TP: John Bookout was very adamant that Shell continue to be allowed to do its own thing.

DM: That's right, as were Carroll and others. We really didn't fundamentally change until [Walter] van der Vijver arrived, unfortunately.

TP: So what were some of the conclusions that came out of this early work by the Turbidite Task Force?

DM: The conclusions, to my mind, were, number one, barring structural complications, turbidites could be amazingly continuous, I mean over miles, which was at least counterintuitive to my thinking, when you have these very thin beds, to think that they can be that continuous. Secondly, that at least they did have the capacity for high-rate production if you had the proper completion systems. It wasn't just simple gravel pack; it was frac-and-pack or water-packs, and those were way back in the early days, but you could, in fact, get high-rate completions. Mark said earlier 2,500 barrels a day was kind of the upper limit of the analogs and it was below the lower limit of what we could commercially justify. I think, if I remember correctly, that we justified Auger on 5,000 barrels a day per well? Does that sound right, Mark?

MS: That sounds right.

DM: Yes. And wells routinely came in at what, 10,000 barrels a day at Auger?

MS: Yes.

DM: And on a voided basis were 20,000 barrels a day, so it exceeded our expectation, but we had to screw up our courage to get it to 5,000 barrels a day. And similarly with the ultimates; I mean, we had to give it enough connectivity and enough drainage area. We designed Auger, if I remember, to have twenty-seven development wells, including water injection.

MS: Yes, we had contingent water-injection slots.

DM: And we ended up drilling, what, about half of that before we got it filled up?

MS: Yeah, I'd hate to quote a number, Dave, but it was less.

DM: It was less. We also looked at the disaster scenario because these reservoirs were young, extremely rapidly buried, and therefore highly compressible, and therefore with the drawdown, we were convinced that compaction was going to happen and screw up the tubulars and fail the production sand face, et cetera. In fact, they were highly compressible, but we got more support from aquifers than we had expected. The reservoirs, in fact, stood up better over time than had been predicted, right, Mark?

MS: That's right, Dave. Historically we have lost some wells, probably due to compaction, but it hasn't proven to be as fatal to the well construction as we feared. There was also a lot of work done principally in our lab around how to design a compaction-resistant completion in well design.

DM: That's correct, and how to stage the drawdown on initial production, sand monitoring, etc. So Mark correctly points out, though often we have a largely subsurface focus on the Turbidite Task Force, it did have drilling and production offshoots.

TP: So 5,000 barrels a day was what you took to the board to justify approval for Auger, is that right?

DM: That's right. Plus we included in the economics the likelihood of compaction failures and having to re-drill every well again on Auger, if I remember correctly, to get it the way of putting our wraps around the arms, so to speak.

TP: When was Auger approved? Was it around '90?

DM: No, it was '88.

TP: It was right at the initial stage of this task force.

MS: I would have said '89, Dave, but it's somewhere in that window.

DM: It must have been '89, that probably sounds a little bit better. It took us four years to build it, we put it in in '93, so it was '89.

TP: I talked to Rich Pattarozzi about all this. He tells a story about going to Bullwinkle and asking the production manager there to increase the choke to maybe see what kind of flow rate you might get. Do you remember that?

MS: That's a true story. In addition to modeling, Bullwinkle was an outstanding quality reservoir. In fact, from a porosity and permeability point of view, it was as good as anything we had discovered. So the question was, can the wells do it and sustain it? To their credit, the Operating Division agreed to run those trials, although they were done in baby steps, because they also had their targets to meet.

TP: Do you remember what did you got the wells up to at Bullwinkle?

MS: I don't recall those details.

TP: I think it might have been close to at least 5,000.

DM: I wouldn't be surprised if it wasn't.

TP: That must have increased your confidence.

MS: Well, we knew things worked great in the simulator, but the question becomes what happens near the wellbore. There were concerns about sand pack failure and all the operating sides of it, in addition to just does the reservoir actually have the ultimate potential connectivity. I think the Operating Division was more worried about generating a gas gap or failing their completion than they were about could I actually get 5,000 barrels a day of flow for a little while.

DM: That's right. Another big study effort was at Peccary, right, Mark?

MS: That's right, Dave. We did have some producing analog fields on the continental shelf. So we undertook a field study principally at Peccary, which is a small gas field, because it looked to have the same geological characteristics that some of the fields we were looking at developing, like Auger. So we did a lot of work on Peccary to unravel it and then put it back together, sort of upscale it and see what it might do had it been a deepwater project developed in the way we were thinking about doing things like Auger.

DM: So it was integrated geophysics, petrophysics, reservoir engineering looking at the aquifer modeling, the production characteristics, just as Mark said, and then carried a similar model to Popeye and other places.

TP: Did you have counterparts in other companies that you knew about who were doing the same kind of studies?

MS: I always had the feeling we were pretty far out there. Academia was better. I can still remember going home from work and hearing quotes on the radio hearing from, I think it was the president of Chevron, saying, "I'll drink every barrel of oil that comes out of deepwater" and that sort of thing. The portfolio of different companies varies and so did the views at the time, right?

DM: He mentioned Bauman and some of the others earlier. I think there were some individuals out in academia or industry that probably knew a piece or two or were experts in an area or two, but where we got the leap was in putting all the specialties under one umbrella and operating in an integrated fashion.

MS: I would add, Dave, we weren't tied to an operation, so we weren't coupled to maturing the Auger Field development plan per se.

DM: That's right.

MS: We had more latitude to go and really dig into the technical problems as opposed to producing the economic forecast.

DM: That's a good point. So you all understood that, and that is to say that until we formed the Turbidite Task Force, we had a Development and Exploration Department that was prospect-oriented. And the Turbidite Task Force was set outside of that so we still had the people that were trying to do the development

plans for Auger and Popeye and Tahoe, etc., and then the task force was a brain trust that was given pretty free rein.

TP: Have there been similar kinds of task force that were formed to address problems as you moved further and further into deepwater, into different frontier environments that were similar to what you guys were doing?

MS: I'd have to say yes. My current job is unconventional gas technology, which originally was named the Pipe Gas Task Force, so we replicated the concept a few times over time to try to address these difficult technical nuts.

DM: I guess you could argue that oil shale's organization was similar. The problem was how to put the brainpower and horsepower together in an integrated fashion to figure out how to commercially exploit oil shale. So I think it's a reasonable model from that respect.

Then we also studied some competitor fields, if I remember, Mark. We had Mobil Boxer and Tenneco Chevron; we also had Joliet and the Orca Complex. So there were a number of other areas. Of course, the MMS has got fairly good reporting requirements and data requirements such that we had the ability to go back and mine some of that data. Then we also systematically mined the MMS data to find out the ultimate of every well in the Gulf, how to array them, what have they done versus time, what we could deduce about drainage areas, etc.

MS: We also traded for data, Dave. We did trade for some Mobil data. I'm trying to remember who operated Eastbridge, I think Exxon, but we ended up doing a data trade with them too.

DM: Yeah, that makes sense. Then we were able to get the Tahoe production test approved, largely on the recommendations of the Turbidite Task Force. We didn't want a production test in the Gulf of Mexico; that was the last thing Shell wanted to do. But I think we made a very strong case that a large part of our reservoirs were thin-bedded, Tahoe-like reservoirs, and we just really needed to know about the productivity and lateral extent of those reservoirs. So that was the impetus for the Tahoe production test that was eminently successful, it was safely run, and production rates exceeded our expectations, if I remember, Mark?

TP: Was this before Auger?

MS: It was in that period.

DM: I'll look when I get home, because I've got a Lucite memento of it.

TP: I might even have it here in this book. So the task force ran until about '93, is that right?

DM: I left in '92, so I don't know when it ended. Do you, Mark?

MS: No, because I left before you did. It ran four or five years, I think, in total.

TP: And the force would jump from project to project.

MS: I would say problem to problem.

DM: That's right. They had a laundry list of problems to solve and they just started attacking them and, yes, we would steer it a little bit based on a particular issue in a particular prospect to get that prospect from A to B, because they knew what the tough nuts were and what the key facets were. We devoted ourselves in this discussion a lot to the production side and it was equally as important from an exploration side. We had to figure out how to tie the seismic to net pay when these facies change. What's the reflection coefficient of these deepwater sands, if they're, in fact, over-pressured and compactable? How can you tell and recognize amalgamated channels on a seismic signature as opposed to a sheet? Those were critical issues, because amalgamated channels were more likely to be more compartmentalized than sheets, so that made a difference in your bid calculation, your exploratory drilling location, your development system, etc.

MS: I think that's right, Dave. We had a geologist in the team who used to sarcastically refer to the bump drillers, and, in fact, early on we had the twinkle in our eye that hot lapping systems printed out in the basement were going to be a lot more prospective than sediments at the top of salt relief. That's because of the structural deposition if the salt relief was there first, but also because of structural complications. The classical thing is to go bump drill the top of the salt dome or whatever salt expression you had, and in fact, we did a fair bit of work to show that that wasn't really the best place to start out.

JT: Wasn't that really confirmed at Mars? I think there you got the leases and drilled down-dip.

MS: Actually, I think it was confirmed at Auger. In Auger, the bright spots are the shallow pays. You've got to go back to the vintage of the seismic we had. There were hints of these systems that went out into the center of the basins, but in fact,

_____ [unclear]. That formed the trap and also had a very favorable depositional setting for sand quality and continuity.

DM: Yeah, I think Auger was bought on the bright spots with some hint that there might be something deeper.

MS: Right.

DM: Then given the poor pressure system, we also took another bet because we built the *Zane Barnes* to be a GP4 rig so we could drill Auger. I don't know that many people really connect those two dots together. I mean, we purposely built a rig to drill a prospect.

TP: I think they thought there might be some deeper bright spots, but they weren't sure if they were really seeing what they were seeing.

DM: Yeah. They weren't bright, so to speak.

MS: Right. We had exploration managers with some fortitude, to use a polite word. So we really respect those guys.

DM: That's right.

TP: It took a while, because most of those leases were bought in the early eighties and it wasn't until a few years later that they were drilled.

DM: That's right. So Mars was what we might now term a basin-centered oil, right, Mark? It's that a ponded basin?

MS: Yes.

DM: You're right in the sense of your logical mind says, "I'm going to drill at the upturned edges of these." So the question in Mars, was, is the reservoir in fact out into the basin where it's nearly flat? Mars had a pretty low prospectivity, which was why we brought BP into it, plus the oil price was very low and we didn't have many dollars to spend on exploration drilling, so the only way we could see going forward and keep the rigs running was by bringing in BP. Keeping the rigs running was a never-ending struggle, Mark, as I remember it.

MS: During the lean times, that's true.

DM: So on the one hand, you wanted to stay ahead of the competition, and on the other hand, you needed to drive development. And we knew that if we ever lost the momentum, we were hosed. Fortunately, we never lost the momentum until later when others lost it for us.

TP: Do you remember when Auger first came in?

DM: Both Mark and I were gone when Auger came in.

MS: I remember that day, though, because the very first well, when they turned it on, came in at 600 or 700 barrels a day.

TP: Yeah, right, that's the story I'm referring to. [laughs]

MS: I thought the sky had fallen.

TP: It turned out there was just a blockage in the formation.

MS: Yeah, there was some completion problem that was quickly remedied, but that was a really difficult couple of days.

DM: I do remember when Krebs and Wickizer took Auger to Frank Richardson, who is also a petrophysical engineer. They'd taken a core sample from unconsolidated S sand, and Frank Richardson thought it was too fine-grained and too dirty to ever produce the 5,000 barrels a day we had in the model, right, Mark?

MS: I remember that as well, Dave.

DM: That just scared me. Since I'd made the recommendation, it was pretty scary for him to say that, and I just had to say, "It will! What more can I tell you?" So it was a tough sled to get that over the goal line.

TP: Yeah, because you were in a steep downturn.

DM: That's right. But we just kept stumbling into good reservoirs. I mean, Mensa is a reservoir that just blows your socks off, right, Mark?

MS: Yes, absolutely.

DM: Those wells made 100 million, 120 million a day. It was three-quarters of a TCF that was just big and bright on the seismic like there was no tomorrow. As my old

petrophysical boss, Alan Wise, used to say, "I've drilled into the suitcase sand." That's an old West Texas expression that when you drill into that formation it was out in West Texas, you'd just pack your suitcase and go home because you were out of luck.

JT: What are some of the differences between oil versus gas when you're looking at turbidites? For those who don't study it on a regular basis, are there different challenges, different things to look at?

MS: Gas has a more unique seismic signature, so it's a little easier to differentiate, although there's this little bugaboo called low-saturation gas that bit us a few times. Small amounts of gas have the same effect as large amounts.

DM: But the fact that it's a turbidite as opposed to a marine sand is irrelevant. Turbidites' plumbing is no different than plumbing in other sands, so you produce gas at higher rates from poorer rock than you can at oil. I mean, all the physics are the same.

TP: I got the impression that deepwater is more of an oil play than a gas play. Is that incorrect?

MS: Well, most of our developments are probably oil. I don't know about the Gulf of Mexico-wide, though.

DM: I can't comment. What you forget are even zones that are oil are retrograde condensate or high-GOR oils. The upper two zones at Auger are that way, extremely high GORs. But that's more of a charge issue than the fact that they're turbidites. The Gulf of Mexico's got a lot of oil shallow and as you get deeper, you get gas because of the charge and the temperature. Remember, in deepwater you already have 7,000 foot of water on top of you, so you have to go really deep to get to the gas, as it were, if you were looking at the conventional shelf.

JT: So looking at it geographically, where the turbidites begin is in the thousand-foot or greater range off the shelf?

DM: You have to get off the continental slope, right, Mark?

MS: Yes, that's the right answer. So wherever the continental slope was at the time at the age of the reservoir you're interested in.

DM: Remember that migrated versus time. So basically, you've got a situation where you've got the shelf, you've got the Mississippi dumping in all this sand, and then you've got the drop-off down to the continental slope, and when you get enough of this sand up here that it just spills over the edge and goes "poof;" that's the turbidity current that rolls down the slope and forms these reservoirs. And in a situation where you think you're just like going into a bowl, you push some sand in, and you get a real thin sheet that sits there. Push some more sand in and you get another thin sheet, presuming there are shields on top of that. Now if you start putting bumps in it and salt or topography, then you get situations where that sheet gets disruptive. You focus the deposition and then you start getting channels. It's no different than what you see down at your local lake or stream. It's just under water.

MS: Well, and the scale, Dave.

DM: Yeah, I guess the scale is a bit larger. It's continuous; it can be tens of miles, which is something you wouldn't see in lacustrine or alluvial sediments.

TP: And after Shell proved up a lot of these discoveries and confirmed a lot of what you were studying regarding turbidites, there must have been a lot of interest in what you guys had done from other companies, from academia. Was that the case? Everyone eventually came around to understanding what the characteristics of these reservoirs were.

DM: Well, I think that we had quite a few partners, so a certain amount of the knowledge got out that way.

TP: BP, I guess.

DM: There was BP.

TP: Was it also Amoco at Ram-Powell?

MS: Yes.

DM: Amoco at Ram-Powell and some of the others. I think others learned just by observation once they saw Tahoe Auger produce like it did. I think some of the other operators had overseas operations where they had perhaps had a little experience with turbidites that they were able to bring to bear. But we were fairly secretive, but I don't know that there's any kind of shazam at the end of it, per se.

TP: I'm also wondering what kind of confidence this gave the group, say, in other deepwater areas like the Gulf of Guinea. Is the geology similar enough that you can sort of treat this as an analog for what was happening over in West Africa?

DM: Well, that was the unfortunate thing. We didn't tell the group.

TP: But eventually?

DM: Well, eventually was kind of late in some areas. I mean, we got lost out of Angola because of that, don't you think, Mark?

MS: Primarily.

DM: Yes, because we didn't get the data transferred fast enough. The Group didn't have enough knowledge. It's kind of like even now, when you guys called me, I called up the library, and said, "Send me the highlights of the Turbidite Task Force," which I know Mark and others wrote religiously, and I was only able to find two reports. I don't know if you all ever wrote a big report or unifying theory, do you, Mark?

MS: Not when I left. To my knowledge, not at all.

DM: I found some slide packs that Schuh [phonetic] and others had put together that basically summarize much the work. I guess Dave Nissman wrote a summary, also.

MS: Yes.

TP: So, no big presentation at an OTC, kind of a Eureka moment?

MS: In the early nineties—and Pattarozzi would be the right source for this—we decided that the industry was down and that we were going to take on more partners, so we had a pretty concerted PR campaign for some of this work. So there was one of the particular AAPG conventions—and I'm sorry I don't remember which one it was—where we had a very heavy presence. We presented much of the work we'd done on the Shell analogs and the outcrops and the things Dave has described for Shell. We did that explicitly to get people interested in this play so they potentially would become partners with us. The concept was that if we showed our work, they'd show theirs and we could all learn together.

DM: I think that's right. I think probably the biggest area where things were published is on the geology side in the outcrop studies. I know some of that was shared in the AAPG by the guys that worked for us or used to work for us still run field trips that use some of those concepts.

TP: I think Gary Steffens gave me the script to a slideshow presentation that he gave on some of this stuff.

DM: That's probably right.

TP: Well, I think we might have exhausted your knowledge and time and patience. Let us know if there's anything else you think we should know about the work that was being done and contributions it made to the success in the deepwater.

DM: Well, we got into deepwater with the foresight of some people like Tom Hart, Carl Wickizer, and Gordon Sterling, who thought that the exploration could work, that the production could work, that we could do the structures, etc., so that was where we had to go. I think what the Turbidite Task Force gave us, at least from a subsurface production standpoint, was the necessary information to be able to take the step to do Auger and hence the subsequent developments, and proved that they could be economic so we were able to leverage that into additional prospects to keep the deepwater going. It gave us just fundamental new understandings of high-rate, high-ultimate wells, reservoir performance, etc. So it really got us up the learning curve and gave us the data-driven confidence in the decisions we were making.

TP: When I first started looking at this I'd go back to see these *Business Week* articles or *Wall Street Journal* articles, and the tones were, what does Shell think they're doing out there in the deepwater? It can't possibly be real. It's the Dead Sea and it's way too expensive.

DM: Yeah. So equal credit goes to the facilities guys; they probably were more revolutionary than the subsurface guys, wouldn't you think, Mark?

MS: Yes, in many ways.

DM: Some of the things they came up with and had to overcome; that's iron, that's hard work, and they were just as visionary and really took some great risks in how they ended up. I can recall trying to look at the development scheme in deciding if we were going to use spars or floating FSPOs or TLPs and what kind of TLPs. We just kept going round and round those operating models.

TP: We interviewed Dan Godfrey, who was involved in a lot of the concept design, and that is an amazing story. There are so many amazing parts of the puzzle, and when you put it all together, it almost blows your mind that this could be pulled off in such a tightly integrated way.

Do you have anything to add, Mark?

MS: Let me add. Sometimes I am afraid the Turbidite Task Force gets too much credit. It was really a technically integrating and a de-risking group, but the lion's share of the work that led to the development of Mars or Auger or any of these other things were done by the teams working on them.

TP: Yeah, the project.

MS: Yeah. So that was 98 percent of our staff, and they were good about using what we were coming up with and asking the right questions, but I wouldn't want this effort to be taken too much out of context like it's the miracle cure for everything.

TP: I'm just interested in the effort to get a global understanding of this play.

MS: We took a huge risk, right? In the end we took a huge risk because we had just never achieved anything like what we were proposing to do anywhere, and we were doing it in an environment where we had never built or executed a project in this kind of operating environment either, so every dimension of this venture was a challenge.

TP: About the same time, the leases you got up in offshore Alaska in the Arctic were not uncovering anything, and so you really had to double your efforts.

MS: I want to build on what Dave said. I think what Shell Oil actually did was it had a three- or four-pronged effort; the Eastern Seaboard, the deep waters off of Mexico and offshore Alaska. Offshore Alaska was interesting. We made kind of three big bets exploration-wise and one of them came in.

TP: I think that's a pretty good percentage.

MS: It was a necessary one, come to find out.

TP: Talking to Carl, too, the East Coast wasn't a total loss, because you demonstrated that you could drill in extremely deep waters on the East Coast and then you took that drilling experience into the deepwater Gulf.

DM: That's right.

TP: Well, I think we can stop here. We appreciate your lending us your time. Thanks, Mark for getting on the phone with us.

MS: You're welcome.

TP: We'll send you a transcript and let you look at it when we get it done.

MS: Yeah, I'd be interested in the final product some day.

TP: The book I wrote has a little bit of this story too. I'll give Dave a copy of it. I know Bellaire and Wood Creek bought a bunch of them, so if you're interested.

DM: I'll look at it and send it to you, Mark.

MS: Yeah, you're going to produce something from this, right?

TP: Oh yes. It's a follow-up on this Shell offshore history, but it's not looking just at Shell but at the entire industry.

MS: Oh, fine.

DM: Good.

TP: Thank you, Mark.

MS: All right, take care.

[End of interview]