INTERVIEW

An interview with Carl Reine

SOUND QI SOLUTIONS LTD.

INTERVIEW COORDINATED BY SATINDER CHOPRA

Carl Reine is an active and aspiring geophysicist working at Sound QI Solutions Ltd. in Calgary. During his 18 years in the industry, he has proved his effectiveness as a promising reservoir expert. Warm and straightforward in his mannerism, Carl readily agreed to our request for an interview, and shared his impressions/opinions on various topics ranging from his background to what he specializes in. His interesting and insightful comments on these and other topics are contained in the following interview.

Carl, let me begin by asking you about your education qualifications and work experience.

I went to the University of Alberta for my undergraduate degree in geophysics and graduated in 2000. I did my first two years as a physics degree, with different career plans in mind, but when I did some more investigation into what would come after university, I decided that I needed a new plan. The practical application of physics in geophysics was appealing, and it was an easy switch. The only problem changing programs was scheduling the introduction to geophysics course, which paradoxically I had to take in the last semester of my final year.

After U of A, I got a job working for Canadian Occidental (which became Nexen and is now CNOOC) working on projects in SE Saskatchewan and the Lloydminster area. It was good experience, but I still had an interest in going back to school. So, after six years of working, I took time off to go to the University of Leeds in the UK. It was originally supposed to be for a master’s degree, but I was thoroughly enjoying my project and the experience, so it turned into a Ph.D.

When I came back to Calgary in 2010, the job market was tougher than when I graduated the first time. Thankfully, through my connections at Nexen, I was able to get hired back into their shale gas group, where I stayed for three years. In 2013, I made the switch to the service industry, getting a job at Canadian Discovery in their geophysical consulting group. In 2017, that group became Sound QI, where I continue to work today.

You went to the University of Leeds to pursue your Ph.D. How come you decided to leave the country? How was that experience? What differences did you perceive between the University of Alberta and the University of Leeds?

My wife and I had discussed our interest in living abroad for a while, and the prospect of going back to school over a fixed time period seemed like a perfect opportunity to do it. I started looking into professors that were doing research in the field of seismic attenuation - something I had developed an interest in since starting work. The University of Leeds had a long history of practical research into attenuation measurements, so it was an ideal choice.

I had a great experience in Leeds, and admit it was quite different from what I was expecting. Going to university a second time, but ten years older, having finished a degree, and having worked for six years makes it almost impossible to compare the two experiences. At U of A, I felt more a part of the university as a whole, whereas at the University of Leeds, I felt more connected with the geophysics department and its workings. Those differences likely had more to do with being an undergraduate versus graduate student. Really, the two universities are similar in many ways, such as in their size and the programs they offer, and most of the differences I can think of relate to the settings and cultures.

After working at Nexen for 9 years, you moved to Canadian Discovery, then Sound QI. How did you decide on doing this?

Switching to a service company was a result of wanting to focus the type of work I was doing. I do miss that, at an E&P company, a geophysicist gets to be a part of all things seismic, from acquisition to processing to interpretation and analysis, in addition to helping with business decisions. However, I really enjoy technical seismic analysis, and on the service side, that is definitely where you get to focus your time. I had just finished some interesting projects at Nexen, and the opportunity to make the switch to Canadian Discovery came at the right time. The change into Sound QI has allowed even more geophysical focus, and I’ve had the chance to work on some great projects.

Apparently, your stint at Nexen made you attend to unconventional resource characterization, which included heavy oils, shale gas, etc. Would you say you were lucky to get that experience before unconventional resource characterization became the buzz words in our industry?

Working in heavy oil early in my career was the first time I was involved with using geophysics to provide information about the reservoir and its fluids. Changes in lithology, porosity, or the presence of bottom water, were all important considerations into how wells were planned. I got to work on a 4D project for a steam injection pilot and had to learn about fundamental rock-physics properties. Also, the opportunity to work on fields with differing geologies, combined with the reservoir characterization work we were doing at the time, I would indeed say was a lucky experience.

My experience in the shale-gas group, looking at the Horn River Basin, started in 2010, when these projects were getting a lot of attention. The acquisition of new seismic and microseismic, pad drilling, and the integrated analysis that was possible, was something I was fortunate to be a part of, early on, for that play type. The biggest learning was from having so many professionals working together on one project. I had the chance to see how others were working on things such as geomechanical and fracture analysis, well planning, and completions design, where the scope and expectation of the analysis were much larger than for typical conventional plays. It highlighted how geophysics could be advantageous to field planning, but also brought out the challenges of communicating those advantages, which is still an issue today.

Your research work for your Ph.D. was on robust determination of Q from seismic data. Why is it that after four decades of research efforts on Q determination and application, our industry still does not determine and apply Q compensation confidently to seismic data, during processing?

When you just look at it from a signal improvement point of view, there are a few options to compensate for attenuation effects: inverse Q filters, which are becoming increasingly stable; prestack migration algorithms that incorporate Q compensation; and even just spectral balancing algorithms. The apparent inattention to detailed Q models for processing is likely because frequency recovery is not overly sensitive to a Q value of, for example, 75 vs. 100, as demonstrated in a number of papers. As a result, these algorithms are often run with a single-value model. No one has gone to the effort of calculating a complex model because the approximate Q does a decent job. I think most geophysicists are comfortable with what spectral balancing algorithms can already do.

Now, whether or not the lack of Q compensation is universal, I'm not sure. It is definitely an area of active research from some Chinese universities and companies, where there are many examples of Q estimates for compensation methods. I don't know enough to say whether it is just one of their research strengths, or if it is more commonly applied in the industry there, as well.

Skiing at Lake Louise in 2022

However, the biggest advantage of accurately measuring attenuation lies in the information it can provide for reservoir characterization. The same Q range that has minimal imaging benefits can reveal important geological changes such as fluid saturations or fractures. I'd like to see more Q calculations for reservoir characterization purposes, which would add an extra dimension above the elastic properties we already use. Once we have more published examples of how attenuation is used, and what the benefits are, I think it will become routine, in the way that AVO inversion has become routine at present.

What do you think are the challenges in determination of Q from seismic or VSP data using the older spectral ratio method?

I am actually a bit biased in favour of the spectral ratio method because it offers so much flexibility in its use. I think the challenges arise when it is viewed as a simple linear regression with no interpretive input. A common issue is that when an inappropriate frequency bandwidth is selected, the results can be biased. However, as an inverse problem, the spectral ratio method has many tools at its disposal. For example, different frequencies can be weighted based on their relative uncertainty (e.g., weaker components get a lower weighting). The inversion itself also doesn't have to be a simple linear regression with respect to frequency. All of inverse theory can be applied to the problem, using multiple variables (e.g., time), regularization, or different robust algorithms. The spectral ratio method can also handle a frequency-dependent Q, where other methods would need to be redesigned completely to handle that situation.

When you combine all of the options and available tools along with some assessment of the appropriate parameters, many of the apparent challenges of the spectral ratio method can be overcome. If you are using a single pair of VSP receivers, a simple linear fit, and a default bandwidth, your Q estimate will be disappointing, but using a bit more effort, to include more data and analyses, will give a much more robust answer.

You have had a wide variety of projects over the years. What areas of geophysics and reservoir characterization would you say interest you the most?

I enjoy taking the recorded signal and calculating information from it, which is why AVO inversion and attenuation both interest me. I also find matching theoretical models to observed data very satisfying. Extensively using both concepts, 4D projects are probably the ones I find most interesting. With 4D, there is an inherent goal of not only characterizing the reservoir, but also disentangling the different effects caused by production or injection. The rock-physics modelling aspect lets you build a catalogue of expected property changes, and then you have to logically hunt through the data to attribute those changes to the reservoir scenarios. In my experience, 4D projects also have the most collaboration with people from other disciplines who are eager to share what they already know and learn what seismic can add.

Since you have worked with azimuthal AVO inversion, in your experience, how promising is it, and how does it compare with other methods adopted for the purpose?

I don't know if I have enough expertise to compare the different azimuthal methods, but I am always impressed by how many observed behaviours can be found to match with changes in azimuthal properties. In the first azimuthal inversion project I worked on, we found anisotropy that matched very well with the small-scale faulting observed on the seismic, changes in microseismic behaviours, and ultimately, changes in production. I've also seen azimuthal velocity analysis incorporated into interpretation, where the anisotropy correlates to horizontal-drilling issues that were encountered, such as decreased rates of penetration. As attributes, the magnitude of anisotropy and direction of change are useful; however, the progress being made on extracting information about fracture density or geomechanical properties from azimuthal changes (AVAz, VVAz, or inversion) is very interesting.

It is generally said that for effective characterization of shale reservoirs, an integration of geophysics and geomechanics is required. In your experience, how much of this is being done, and what are the challenges in accomplishing it?

I've worked with some impressive teams, where there are geophysicists, geologists, petrophysicists, engineers, and geomechanics specialists engaged throughout the project, trying to incorporate each other's work and learnings into their own. The planning that they are able to come up with is sound, and while I don't have a crystal ball, their field developments can only be more successful because of it. Yet for every great team, I still know geophysicists working on shale plays who are trying to convince their colleagues or company that seismic data could be useful to solve some of their challenges… so we're not quite there yet. I know that some people say geophysicists must be able to sell their ideas, but I think it's poor management to hire professionals and then require them to justify their existence, rather than set broad expectations of collaboration.

Geophysics and geomechanics are a great example of how an integrated analysis can be beneficial. There are multiple points along the geophysics workflow where it can be useful to integrate geomechanical knowledge, whether it's stress orientation data, fracture properties, or rock-physics parameters. Likewise, there is useful spatial information that geophysics can provide as input to geomechanical workflows, so predictions can be made as properties change away from existing wells. The challenge is for both disciplines to recognize the limitations on their data and be willing to incorporate each other's work.

Relaxing with the rocks on Kananaskis Peak in Elbow-Sheep Provincial Park, 2021.

What are your impressions about the important developments people can expect in geophysics in the near future?

I don’t know what big changes might come to the technology we use. It always seems to me that the most impressive changes come from the continuous and steady improvements that look big over a longer time period. As an example, interpretation software now versus 25 years ago would show a stark difference. But those differences involved computer developments, picking algorithms, visualization concepts, research in attributes and synthetic modelling, that you couldn't typically attribute to a single year or even 5 year block. They just happen continuously.

The biggest change I anticipate is in what is expected of a geophysicist. When I started working, AVO and inversion existed, but few geophysicists seemed familiar with them or comfortable suggesting them as part of a workflow. Now, it is common to see people integrating them into their analysis, and companies are starting to expect it. I don’t think that this change is because of drastic developments in the technology, but rather geophysicists as a whole becoming more familiar with the concepts.

I think the same progression of expectations will be true in the near future, driven by changes in staffing levels and the new industries that geophysics is becoming involved in, such as CO_2 sequestration or geothermal energy. Geophysicists will be expected to know more about developments in acquisition technologies, processing workflows, quantitative interpretation, and integration with other disciplines. Technology will continue to develop, getting smaller/larger, faster, and more accurate; but, with a reduced presence, geophysicists will need to be ready to show where their work can be of benefit.

How do you look back at your career so far, in terms of your accomplishments?

There are definitely highlights of my career that I look back at as important pieces in the development of my understanding and enjoyment of geophysics. I try to share with others why I think it was significant, but the things I can list are really what I consider useful from my perspective. How much these activities accomplished or the benefit they provided might be viewed differently by others.

A highlight for me was the work I did at the University of Leeds. Not just the final product, but the process of developing a research plan that covered every necessary aspect, then finding a way to implement each part so it would hold up to scrutiny. That process solidified how I work, finding a way to justify processes and conclusions. It was also enlightening to find out how much you can accomplish with just an idea and some coding skills.

A number of other projects have helped me to learn, and I still think back to them. The integrated azimuthal inversion project I mentioned was significant because it involved input from so many different data types. The 4D analyses I've done stick out in my mind: how they've evolved to include rock-physics classifications and integration of time shift data into the inversion process. Implementing a wide array of rock-physics modelling into our consulting workflow has been both practical and educational. And finally, working with a number of summer students and new geophysicists has helped me to better understand what I do, and hopefully I have been able to give them some insights, as well.

What are your aspirations for the future?

Well, geophysically, I did say it would be nice to see more examples of seismic attenuation being used for reservoir characterization, and as a geophysicist familiar with both, I suppose I was basically volunteering. I would indeed like to bring attenuation estimation into the same sphere as elastic properties, to give that added information. It would be great to find a suitable project and partner to demonstrate Q contributions, and then continue to build on that workflow.

Carl, I have found you to be very quiet whenever I have met you at conferences or luncheons. If I were to ask you to list three qualities that would reflect Carl's personality, what would they be?

Hauling equipment for the University of Leeds field school in Bishop Wood, North Yorkshire, 2009

Instead of "quiet", I would select ‘reserved’ coming across as quiet. It is probably fair to say that I’m not a big fan of large gatherings where there is competition for attention. But I think that in a situation that allows for a focused conversation beyond small talk, I am anything but quiet. "Determined" is also probably on the list. I don’t accept that there isn’t a way to do something that I’ve decided needs to be done. If I have to pick a third, I will go for "adventurous". Not in the ‘race from the North Pole to Mt. Everest on a unicycle’ sense, but I always like to explore and try new things.

We all have a driving goal or goals in life. What has it been for you all along?

“I want to try that.” From a work perspective, “that” might be a new technique that someone demonstrated, or an idea I’ve had, or someone else has proposed, while considering a problem. Outside of work, that is how I’ve found many of my favourite activities. It goes back to the comment about being adventurous - if something looks interesting, I want to try it out and follow through until it’s done, or I’ve failed miserably, or it isn’t interesting anymore.

Outside of the work that you do for a living, what other interests do you have?

I’m a big fan of playing in the mountains, which makes Calgary a rather good base for work. Hiking, skiing, and climbing are all on my weekend wish list, and I think we’ve successfully convinced our kids to accept those, as well. I look forward to any activities with my wife and two children, even if it doesn’t involve the mountains, and I still enjoy playing, and now coaching, basketball. At home I’ve become a bit of an amateur cartographer, building topographic maps that feed some of my other interests.

What would be your message for youngsters who have joined our industry recently?

Go to talks… even if you don’t understand anything they’re saying. Just pick out one detail, no matter how small, and try to understand its relevance. Then go to more talks. Eventually, all of the things that you didn’t understand at first start to show up again in different places. You’ll learn more and more and eventually find that you’re an expert.

I don’t like the word ‘expert’ because it implies knowing something that is out of reach for everyone else. Really, that’s not the case, it’s just about being persistent. But find some part of your job that you’re interested in and become an expert at it. Maybe it’s the software you use, or the interactions you have with companies and people, or a specific job function. Learn every aspect from co-workers, papers, help files, and then help the people you work with understand what possibilities exist. Using software as an example, I see so many features designed for a specific purpose with no one who knows what these features do, or why. Be the person who understands them and helps bring success to your team. When you have a skill set that can benefit your work and team like that, you become indispensable as a geophysicist.

And finally, what question (which I apparently may have missed out on) would you ask Carl, if you were in my place? And what would be your answer?

I can't honestly think of anymore. I appreciate the chance to answer the ones you've posed, and I feel honoured to make the list of geophysicists you've interviewed over the years. Thank-you.