INTERVIEW

"Ours is a high-tech industry which still has a bright future"

— An interview with Olivier Dubrule

Oliver, Rainer and Satinder in conversation with Olivier Dubrule (Photos courtesy: Vince Law)

Olivier Dubrule was in Calgary recently to deliver his 2003 SEG Distinguished Short Course on 'Geostatistics for Seismic Data Integration in Earth Models'. RECORDER Editors were able to squeeze some time into his busy schedule to interview him. Rainer Tonn, EnCana Corporation also joined in the interesting conversation. Olivier was quite relaxed, responsive and enthusiastic in sharing his impressions/opinions on various topics ranging from his background to his favourite subject and what he specializes in. The following are the excerpts.

S: Please tell us about your formal educational training and your professional experience.

O: I graduated as a civil engineer in 1978 from Ecole des Mines de Paris. This was the late seventies, and the Ecole des Mines' "Centre de Géostatistique" was developing new methods and applications for the petroleum industry. I was offered the opportunity to work on a Ph.D. with Prof G. Matheron, the father of geostatistics, as my thesis director. I enthusiastically took up this opportunity and obtained my Ph.D. in 1981, then was offered a job by Sohio in the United States. I spent four years there, working mostly on the reservoir modeling for the Prudhoe Bay Field. At that time, geostatistics was used mostly through kriging, for mapping petrophysical properties across the field. Then I went to work for Shell International in the Hague for five years. These were the mid-eighties, and geostatistical reservoir characterization was taking off. Object-based models and indicator simulation were subjects of great discussion, but most companies at the time were developing their own software. In 1991, I moved to Elf, to head a reservoir characterization project. One of the results of the project was the first geostatistical inversion software, developed in cooperation with Stanford University. In 1994, I started a new geological research group at the Elf Geoscience Research in London. We developed geostatistical techniques related to seismic data interpretation, with new tools for structural uncertainty quantification and geostatistical inversion of both seismic and production data. After the merge with Total, I became head of the Earth Modeling and Uncertainties group, where we had gathered all the expertise related to uncertainty quantification, earth modeling and geostatistics. Since 2001, I have been manager of Geoscience Training and Technical Image at Total. Thus, after focussing on technology development, I am concentrating on technology transfer, which is a great experience. DISC is a significant part of this activity.

S: How did you get drawn into geostatistics?

O: There are three things I find very exciting about petroleum geostatistics. First, I am fascinated by the challenge of modeling nature. In fact, I do not like the term "statistics" in geostatistics very much. To me the challenge of geostatistics is to quantify geology, using all the data and information available from all disciplines. In most cases it is not a matter of computing statistics on data, because there are not enough data anyway. It is rather a matter of working with geoscientists and reservoir engineers to extract quantitative information from analogs, or from seismic and production data. Another thing I like about geostatistics is that even if many successful applications have already shown its value, it is still struggling to find its place in the petroleum geoscientists workflow. I like the challenge of introducing new concepts and techniques. To achieve this, you first need to understand which tools and techniques are used by the various disciplines, then you need to do a lot of training, selling and convincing. This brings me to the other reason why I like geostatistics, probably the main one. Because it is a technique for translating geological concepts and available data into 3D models, it acts as the "glue" linking the different disciplines together. That means it requires strong interaction with all people involved in the modeling process: geologists, in order to generate realistic geological models, geophysicists, in order to use geophysical data as constraints, and reservoir engineers, in order to make

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sure our models match dynamic data, and help improve our production forecasts.

S: In simple terms how do you explain the promise of geostatistics?

O: After giving my DISC course four times, I can reflect on two things. First, the interest this topic generates: about 200 people in Houston, 60 in Midland, 60 in Denver and again close to 200 in Calgary. I am also impressed by the geostatistical experience most course attendees already have. I would say more than half of them seem to have already practiced geostatistics in operational situations! To come back to your question, this means geostatistics has not just delivered "promises" but actual results! Let's mention a few I describe extensively in my course. Kriging is used worldwide for mapping, and techniques such as collocated cokriging or external drift are now the standard industry techniques for combining seismic and well data. Factorial kriging is a great way of removing acquisition artefacts from seismic data. Conditional simulation has been used for years in many companies – such as Total – as the main approach for generating 3D reservoir models. Geostatistical inversion has been developed enthusiastically by software vendors. Geostatistics-based uncertainty quantification remains a bit controversial, but has been used successfully in my company for about five years.

S: Ever since Doyen presented his paper way back in the 1980s, there has been talk about geostatistical techniques, but I believe it has picked up more in the last 5 years. What do you think is the reason for this?

O: The progress of geostatistics has gone hand-in-hand with major software breakthroughs. In the early seventies, mainframe mapping programs helped spread the use of geostatistics, mostly within major petroleum companies. But these programs remained difficult to use, and very expensive. Then, when André Journel arrived at the Applied Earth Sciences Department at Stanford University, he came up with the great idea of free software. Suddenly, thanks to Gslib, everybody could try geostatistics on their data at almost no cost. However, there was no real commercial industry software available yet. This only happened in the early nineties. Recently, the rapid development of earth modeling programs has accelerated

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this trend. There are now excellent software tools on the market, both in the area of 3D earth modeling and 2D mapping.

S: I remember, personally, I was first exposed to cokriging in 1988-89, when it was used to generate porosity maps within reservoir zones. Why do you think it took so long for geostatistics to get accepted as a viable method?

O: 1988 is the year where Philippe Doyen's classic 1988 paper about cokriging was published in Geophysics. Philippe showed how you could use cokriging to map porosity using well data and acoustic impedance information resulting from seismic inversion. The paper generated great interest, but the cokriging approach was complicated to use. You needed to model the variograms of porosity, of acoustic impedance, and the covariograms of porosity and acoustic impedance. Also the cokriging system was complicated, and at the time there was not much software available on the market. A useful simplification came with collocated cokriging, which was promoted by Xu four years later, in 1992. It was a simplification of cokriging, whereby you only needed the porosity variogram and the correlation coefficient between porosity and acoustic impedance. This was an important step in the development of petroleum applications.

S: Do you think geostatistics can be followed or understood without getting into the mathematical rigor it entails?

O: Of course it can, I would even say it should! It is clear a number of geoscientists do not have the mathematical training to understand all the math. There is a great Groucho Marx quote which I use in my course "Who are you going to believe? Me or your own eyes?" Geostatisticians must be able to explain in simple terms to the geoscientists what are the assumptions that are used and how they impact the results. This is one of the things I try to do in the DISC. The assumptions and the limitations of the models must be explained in plain language, not with triple integrals. It must also be shown that geostatistics actually adds value, not costs!

S: In geostatistical inversion, as I understand, a stratigraphic grid is first created using picked time horizons. Then lateral and vertical variograms are computed from seismic or log data. If the seismic data quality is good, geostatistical inversion results, as they will mirror the quality, can be expected to be reasonable or giving you more confidence. If the data quality is not optimum, do you think use of geostatistics is going to be a whole lot better?

O: If the data quality is not very good, many deterministic techniques will still provide you results, without any uncertainty attached to them. On the other hand, if you run geostatistical inversion on data that are poorer quality, the uncertainty quantification provided by geostatistics will flag this. It will actually tell you whether the use of your seismic data significantly reduces the uncertainty affecting the reservoir model.

S: Are we able to account for anisotropy in the data by way of variograms?

O: This is one of the key benefits of using geostatistics, as compared to other approaches such as spectral analysis or filtering techniques. The variogram allows you to account for anisotropies related to geology, but the use of anisotropic models can also help you filter seismic acquisition or interpretation artefacts from stacking velocity picks, by selectively removing artefacts that are either in the in-line or the cross-line directions.

S: Seismic impedance inversion is non-unique. Geostatistical inversion provides a mathematical framework for quantification of this non-uniqueness. A further difference is that geostatistical inversion can give results that have higher frequency than the input seismic data. To what do you attribute this higher frequency?

O: The higher vertical frequencies come from the vertical variograms calculated from well data. The variogram provides you the same information as the spectral density. Using geostatistical inversion, we make sure the realizations we generate have the same vertical variogram everywhere – or the same frequency spectrum - as that derived from the well data. Of course, because these frequencies are not in the seismic data, much uncertainty is attached to each high-frequency vertical trace generated with geostatistical inversion. But the models obtained provide a much more realistic image of the heterogeneities that occur between the wells.

R: In the earlier days of geostatistics I had the challenge of convincing my old company's management of the benefits of geostatistics. I remember one of my old boss' attitude: geostatistics or statistics is like a witch, depending how you tweak it you will get what you want. Now I see the opposite trend, as long as not all parameter variances are calculated, an expensive well will not be drilled.

O: There is the wrong perception sometimes that "if you know nothing just use geostatistics". I keep saying to our geologists that if you cannot draw a conceptual map or a cross-section or your geological model, you should not bother using geostatistics. Also, is it necessarily a wrong thing to "get what you want" with geostatistics? Again, this is a technique for translating geological knowledge and data into a 3D representation of the reservoir with which geoscientists will feel comfortable. If the geologist does not like the model, it means something went wrong somewhere: either some of his knowledge has not been incorporated in the model, or the geostatistical method that has been used is too limited to handle all the available information.

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R: In geostatistics I am always concerned about our limited and biased database: In geostatistics we have a limited number of hard data points – our wells. All wells are drilled at preferred location and then we run the statistical analysis. Can you comment on this serious problem, please?

O: Again, I do not think that in most cases we have the luxury – or even the desire – to "run a statistical analysis". The first thing you must do when running a geostatistical study is to sit down with the geoscientists and the reservoir engineers and pick their brains. How much is known about this reservoir – and this includes not only data, but also regional or analog-derived geological knowledge - that can be built into the quantitative model? Sure, wells may have been drilled at preferred locations; but, all geoscience interpretation approaches have to account for this, not only geostatistics! This is why, when we do time-to-depth conversion, we prefer to use as much velocity information as possible, from stacking velocities for example, rather than limit ourselves to depths at the wells and seismic times.

R: One critical issue in GS is the data preparation. In particular I am thinking of problems with upscaling. Do you believe the tools we have available are really leading edge or do we have a long way to go?

O: When dealing with seismic data, you may have more of a downscaling than an upscaling problem, while in reservoir engineering it is more of an upscaling issue. I think we need better tools to handle downscaling of seismic data, and this is a question that is often asked of me during my course. For instance, how do I use an attribute map to constrain a 3D stochastic reservoir model? How do I use seismic data available every 12.5 m to constrain a reservoir model sampled on a 100 m grid? There are examples of studies which have addressed this problem, and I discuss them in the DISC but today there is certainly not an industry-wide accepted approach.

R: The typical geostatistics approach is to use the well data as "hard data" and seismic as "soft data". Knowing about the limitations of well data and also being a keen geophysicist who enjoys AVO techniques and seismic reservoir characterisation I wonder whether we have a chance to see a shift. A shift to the situation that engineers accept seismic data (as long as the geophysicists trust them) as 'hard' as well.

O: I do not like this distinction between "hard" and "soft" data, and I never use it in my course. Each data gives us information about a certain parameter over a certain scale, and each data is also affected by measurement errors. For instance, stacked seismic tell us about acoustic impedance, but at the seismic data frequency, and acquisition errors can affect these data. Geostatistics can be used to filter the error out of the data, and generate higher resolution acoustic impedance contrasts data, constrained by the seismic within the frequency bandwidth of the seismic. Then the impedance models can be used to predict porosity, if there happens to be a good relationship between porosity and impedance. Since you mention AVO, there have been very interesting applications of bayesian stochastic inversion to Norwegian fields published in recent issues of Geophysics by H. Omre and A. Buland.

S: Tell us about some new directions where geostatistics is going?

O: In reservoir characterization, I think new geostatistical simulation techniques must be developed, in order to obtain models that are better geologically loaded. Although both techniques have been successfully used, I still believe that indicator simulation is too simple, and object-based modeling too complicated. There must be a middle way, maybe through a better use of Markov transition probabilities in 3D. In the future, we should also see the development of geostatistical techniques go hand-in-hand with that of 3D earth modeling software. If we focus on geophysics, the use of techniques such as external drift and collocated cokriging for combining seismic and well information is now well established. The success of geostatistical inversion opens fascinating perspectives for the industry. Instead of limiting our acoustic impedance models to "most-likely" solutions within the seismic frequency bandwidth, we now generate models at the reservoir scale, and quantify the uncertainty resulting from the introduction of higher frequencies. New applications are rapidly piling up, whereby we can now directly cosimulate lithology and acoustic impedance models, or directly use these models as an input in the construction of the 3D reservoir simulation model. Nevertheless, geostatistical inversion is nothing more than an extension of regularization-based or bayesian inversion techniques, and this must be explained too. Clarifying the relationships between geostatistics and the tools of the trade of the geophysicist is important. Geostatistics is one way to see the world, working in depth or seismic time, and using a probabilistic model to quantify geology. Frequency-domain approaches, or filtering theory have close relationships with geostatistics. These relationships must be clarified, thus geostatistics will be "demystified" and its applications focussed on areas where it can bring most value.

S: What are your work responsibilities within Total?

O: My department has two responsabilities, which are closely related to one another.

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The first is Geoscience training. Geoscience training is organized into geology, geophysics/geocomputing and reservoir engineering training, with one senior engineer in charge of each discipline. We make sure our training catalog is adapted to the needs of the company. These needs evolve with technological breakthroughs, changes in our acreage, and evolutions in the workforce. Today, we especially focus on the training of young people, through the training passport which I will describe later. We also have close interactions with our subsidiaries and their partners. We run a significant number of training projects with them, including both on-the-job and formal training. My department's second responsibility is to promote the technical image of the company. As a major player in the industry, we want the quality of our technical work to be better known. We also wish to support the actions of professional societies such as SEG or EAGE, which help spread technology worldwide. We closely cooperate with these societies, and are very active in technical conferences. Internally, within Total, my group is also in charge of promoting the dissemination of technical knowledge, through websites, seminars or workshops.

S: As Manager of Geoscience Training and Technical Image, what strategies do you adopt to make your job more effective?

O: As I mentioned before, a very important training priority is the development of young people. We believe that, in the three years following their recruitment, young people must be given the necessary skills that will make them ready for operational work in our subsidiaries. In geophysics for instance, we are rapidly implementing a training "passport", which identifies the skills our young geophysicists must acquire, and the training path should be followed to acquire these skills. This passport will be generalized to geologists and reservoir engineers. In terms of technical image, we identify what we call "key conferences" which we believe are events which are especially important for the industry. The annual EAGE and SEG international conferences, together with EAGE Tunis, are examples of such key conferences this year. To reach our ambitions and goals I have, in my group, senior staff who are both well connected and technically recognized within the disciplines. This is a lot about networking both within and without the company.

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S: What personal attributes helped/went against you to achieve the professional status you enjoy today?

O: This is a difficult question to answer! I think when you decide to specialize in earth modeling and geostatistics, you need to accept the fact you are promoting techniques that are new to many geoscientists. New techniques generate interest, but are difficult to incorporate into existing workflows. People must be convinced to change their work habits, and training is crucial in that sense. Take again the example of geostatistical inversion. Some geophysicists are still saying "This is not inversion, this is just random number generation". Indeed, this is not the kind of inversion they were trained in at school. This means, as a geostatistician, you also need to know about the techniques that are used by the disciplines, in order to be able to explain things in the language or the formalism with which they are familiar. To me this is really the fun part of the job. This is also one of the most interesting aspects of the DISC, where I can have access to a large number of geoscientists worldwide in a short time frame.

S: You conduct courses on AAPG platform and you are the DISC instructor this year. How do you feel about these achievements?

O: What I feel best about is the recognition by major societies, such as AAPG, SEG, EAGE, that geostatistics is now an important enough topic to justify the DISC course, or a special AAPG memoir. It is one thing to have your work recognized by other geostatisticians, but an ever bigger one to have it recognized by the largest professional societies

S: What are your aspirations for the future?

O: I believe in technology. I am convinced the main competitive advantage between companies lies in their ability to use new technology in a knowledgeable way. This does not necessarily mean we have to develop this technology ourselves, but we must have a strong enough expertise within the company to QC what contractors do, or to identify which university or research centre is most advanced in each technical area. But, beyond technology itself, the successful companies are those that know how to make this technology available worldwide in their operational centres. This is how I see the role of my department today.

S: How much does serving a professional society like SEG/EAGE help professionally?

O: Societies such as SEG or EAGE promote the development of technology by encouraging the spread of this technology through training and technical presentations. My company strongly supports actions such as the DISC. By being involved in professional societies, you contribute to the technical development of the industry in all countries, but you also receive very much in return – you understand in which area, as a company, you have a technical edge, and in which area you need to improve. Without such participation in professional societies, there is no way you can evaluate how well you are doing as a company.

S: What are your other interests?

O: My family – Anne and I have four children aged between 11 and 21 – is my first priority, which is difficult considering how much I will be on the road giving the DISC! On a more personal level, I always have a weakness for nonsense humor. I never get tired of reading the books by Lewis Carroll or watching movies by Groucho Marx or Tex Avery. Sometimes this even puzzles my children!

S: What advice/message would you give young entrants in the industry?

O: I would tell them this industry is a high-tech industry that still has a bright future in front of it. You have a tremendous choice of jobs, some of them very operational, others more technical. Every three years, you can move to something new, and learn Obviously, it is also very international. For instance, Total has important operations in places such as Africa, the North Sea, Indonesia, South America, and in the Middle East. How many industries can provide such a variety of jobs? We must make every effort possible as an industry to attract young people.

S: Have you volunteered for any professional society?

O: I have been an Editor of the EAGE Petroleum Geoscience from the year it started in 1994 to this year. I have also particularly enjoyed being involved in the organization, as committee member or chairman, of meetings and workshops jointly by EAGE, SPE, AAPG or SEG. I have also been active in the IAMG, the International Association of Mathematical Geology, which has strongly promoted geostatistics in the last thirty years.

S: Olivier, I thank you very much for making the time to talk with us.

O: I really appreciate the opportunity. Let me thank CSEG for organizing this discussion. This DISC is a once-in-a-lifetime experience, and Calgary – my largest audience along with Houston – will certainly remain one of the highlights of my tour. R