



Fifth EBN-TNO one-day workshop on



# Using seismic amplitudes for high-grading prospects and reservoir characterization

Januari 14, 2010

## Panel discussion on the use of seismic amplitudes

Panel chairman: Prof. Dr. Ir. Guus Berkhout

Panel members:

Paul de Groot, dGB Earth Sciences - Enschede

Matthias Bruehl, NAM - Assen

Jo van Buggenum, Wintershall, Rijswijk

Rob Arts, TNO/Technical University - Delft

Bernard Geiss, Total - Mariahoeve

Han van Gils, GdF-Suez -Zoetermeer

The chairman (*Guus Berkhout*) started with an introduction of the subject of amplitudes and in particular contour stacking:

“Amplitude analysis has brought the industry new excitement and surprises. The focus of this meeting will be particular on *stacked* amplitudes, a subject that has been with the seismic community for more than 50 years. Stacking helped us to improve the signal-to-noise ratio significantly, but it also destroyed much amplitude information. Now, the new development is ‘contour stacking’. This new tool may give exploration in Rotliegend and Bunter a new impulse. The common contour technology, therefore, will be very important for the Netherlands.”

The panel discussion was split in three major topics:

- **Common Contour Stacking**
- **Improvements in Data Acquisition**
- **Utilization of Multiple Reflections**

## First topic: **Common Contour Stacking**

Q. *Guus Berkhout*: for the panel: **What is the preferred domain for this type of stacking: time or depth?**

A. *Paul de Groot*: Depth domain is the preferred domain. The technique is sensitive to the contour lines. When time and depth structures are not conformable CCB can destroy instead of enhance the amplitude effects.

There is some hesitation within the panel. Comment of *Han van Gils*: We should always be aware that in the depth domain we are dealing with enhanced data.

General remark of *Han van Gils*: Operators will study each opportunity and seek a technique that is fitting. This is different from the block wide approach as was presented by NAM during the workshop.

*Matthias Bruehl*: In NAM we prefer a regional approach to assess the prospect portfolio because of the increased efficiency and the ability to place the individual evaluation into a regional context.

Q. *Guus Berkhout* for the audience: **How many people guessed the correct free water level in the examples of NAM?** There was a very mixed response. Comment *Guus Berkhout*: This demonstrates that the processing and visualization of common contour stacks need further improvements. We also may need 'wisdom of the crowd tools' that support group decisions on the outcome of contour stack interpretations.

Comment from *Matthias Bruehl* that the Land example, used for the vote, was initially impossible to get right, because in this setting seismic cannot distinguish high saturation gas from low saturation gas very well. CTD stacks are not a silver bullet but contribute to the POS polarisation together with geological information.

Q. *Fokko van Hulst*: We have seen that the method has its merit in typical Dutch Rotliegend and Bunter hydrocarbon accumulations. Are there other prospective formations, where it can be applied?

A. *Jo van Buggenum*: For the Carboniferous there have been examples confirmed where the method helps to define the contact as well.

Q. *Guus Berkhout* for the audience: **How many people work with common contour stacking?**

It turns out that the majority of the audience had not heard of the method before the meeting. Comment *Guus Berkhout*: This shows the high added-value of this meeting.

The panel likes to react: *Bernard Geiss* remarks that techniques have to be used in a geological context.

Some discussion on the importance of the geological context follows.

Remark *Bernard Geiss*: Visualization is essential for the shared model. It is an essential method for our communication.

The question was raised in the audience: **Are we not too specialized?**

A. *Guus Berkhout*: Education should not only deal with depth and detail. In multi-disciplinary teams, a high level of abstraction is essential in order to communicate effectively, meaning that in the decision-making process essentials are emphasized and specialized detail is left out. Amplitudes are a typical subject for this conceptual approach.

The audience has a few more remarks on the applicability of the stacked contour binning method: *Hugo Poelen* questions if common contour binning gives the right information in a stratigraphic play. Also *Coen Weber* is doubtful if flat-spots can be seen in complicated stratigraphy. This is echoed in the room that flatspots in a stratigraphic play can have various meanings.

Q. *Guus Berkhout* for the panel: **Do we use common contour stacking in time lapse data?**

A. *Matthias Bruehl*: Yes, a paleo-contact is already a time lapse example.

Q. Rob Arts: **Can we combine the common contour stack with the CFP technology, shown in the gas storage example during the presentations?**

A. *Rob Arts*: Yes, we are already thinking at some kind of visualization. Note that the method is not widely used (yet).

C. *Guus Berkhout*: CFP creates for each subsurface gridpoint a response at the surface (common focus point response). The stack of this response is the seismic image for that gridpoint. By changing the common focus point stack into a common contour stack, angle-dependent information is revealed and a powerful tool may be created to visualize velocity errors.

Q. *Guus Berkhout*: **Are we stretching the data to the limit by applying the method of contour stacking?**

A. *Paul de Groot*: The next real step-change in seismic interpretation is when we (auto-)track hundreds of horizons and use these in our inversions and to construct detailed geologic models. The tools to do this are being developed and I predict that within a few years no one will be satisfied with models that are based on just a few interpreted horizons.

Q. *Guus Berkhout*: **How about the information in the high frequencies?**

A. *Paul de Groot* we are throwing away important information that can be used in the future.

Q. Bert Dijkstra (PanTerra Geoconsultants). Seismic acquisition has been recording data with a 2 ms sampling rate for at least the last two decades. Is it now the time to start using the higher frequencies recorded or is the earth filter too harsh?

A: *Paul de Groot*: At the moment we are using only a small part of the information and we should concentrate more on the total interpretation of the seismic data.

A: *Peter Mesdag (Fugro Jason)* confirms that the earth filter basically doesn't pass the higher frequencies. Processing at 2 ms implies a Nyquist of 256 Hz, which is unrealistic high giving the nature of the earth filter.

*Guus Berkhout* makes a general closing remark on the first subject:

**At this moment we are still using the stacking technology of the sixties (common surface point) and the eighties (common depth point). The sophisticated methods of today are waiting for mass production. In a conclusion of the common contour stack discussion I expect that a step-change will come if we make stacking part of an inversion process. The result will reveal valuable rock and porefill information.**

## Second topic: **Improvements in data acquisition**

General introduction of *Guus Berkhout*: **There is general agreement that we have to invest more in acquisition. The processing potential of conventional datasets is too limited (you cannot extract information that has not been recorded). Saving on acquisition costs is often penny wise, pound foolish! Bear in mind that seismic budgets are small with respect to the overall cost of E&P. It is wise to reconsider acquisition budgets, independent of the past culture. The criterion is how much extra information will be collected!**

Q. *Guus Berkhout* for the panel: **Shouldn't we spend more money on acquisition?**

A: *Bernard Geiss* supports acquisition of new seismic but management has to be convinced that it adds value.

A. *Matthias Bruehl*: NAM is still investing in new seismic but there is lots that can be done with good processing.

Remark: *Bert Dijkstra, PanTerra Geoconsultants*: Seismic has become an integral part of the exploration, appraisal and production process to such an extent that other methods are not considered anymore. Careful economic analysis of alternative methods (e.g. grid drilling) may lead to adopt other non-seismic strategies. Having said this, seismic has been proven to be the right course of action in most cases.

C. *Guus Berkhout*: We see an increasing influence of the seismic method along the total E&P value chain, i.e. from early exploration to late production.

Q. *Max Mulder, Smart*: **Is there something to say about the land seismic vs the offshore.**

A. *Matthias Bruehl*: On land new acquisition did yield very good results. E.g. the reshoot of Schoonebeek (by NAM)

A. *Guus Berkhout*: We need to reconsider our solutions for the near-surface problem. Not based on time shifts ('statics') but full wavefield correction operators.

A few general remarks of *Guus Berkhout* on acquisition:

**Note the interesting new developments:**

- **incoherent shooting, i.e. many coded shots being fired at the same time**
- **robotization of detector systems**

Q. *Guus Berkhout*: **Is there a role for the Dutch state, i.e. should EBN stimulate innovation in acquisition?**

Remark of the audience. The seismic shooting should have a purpose: the play has to be there!

A. *Han van Gils*; EBN should promote areas on the basis of pre-defined prospectivity, seismic acquisition could be part of that.

A. *Paul de Beukelaar*: Look how Norway is stimulating exploration. The Norwegian government is pro-active in the oil and gas sector and is determined to access the full potential of the resources within its boundaries — why leave oil or gas in the ground if it can be

produced, either now or by using future technologies? They use the APA (Awards in Predefined Areas) arrangement. The APA-arrangement is considered important to attract new and smaller companies to the NCS. The purpose of the APA-rounds is to enhance exploration activities in mature areas, where expectations are smaller discoveries that cannot justify an independent development. In these areas the expectation is mostly smaller discoveries that does not justify an independent development. Prudent resource management is to discover and develop these resources before existing infrastructure close down. Companies get deductions and therefore good return on investment

## Third Topic: Utilization of Multiple Reflections

Introduction by *Guus Berkhout*: **The multiples are often treated as noise in the data. Until now, much money is spent to remove multiple reflections from the seismic data. However, the fact is that multiples contain extra information about the subsurface and, therefore, they need be considered as valuable signal. The only problem is that it is not yet straightforward to extract the information contained in multiples. Nowadays, with the advances in compute power and wavefield technology, we should not throw multiples away, but we should transform them into information that cannot be recovered from primaries.**

Q. *Guus Berkhout*: **Does the panel see a technique to utilize multiples?**

A. *Han van Gils*: It is a matter of economics.

A. *Bernard Geiss*: There is room for improvement.

A. *Jo van Buggenum*: There is lots of progress. Multiples will be largely removed.

A: *Matthias Bruehl*: I hope that universities and others will pick up the challenge of multiples as multiples still represent a major challenge in the interpretation of DHIs. A recent industry benchmark showed that there is still a lot to be wished for.

A: Reinoud Veenhof (Cirrus): This idea (MB: refereed to Delft TU idea of using multiples as signal) was raised several years ago and since then little has happened.

Closing remark of *Guus Berkhout*: **There is a new mindset emerging. Use multiples! Initial results indicate that multiples give extra illumination, and therefore, better imaging and inversion results.**

Conclusion of the panel discussion by *Guus Berkhout*.

- **Until the 80's, travel times of primary reflections were used only**
- **In the 90's direct hydrocarbon indicators signal the large value of amplitudes**
- **Now, full waveform inversion techniques use both traveltimes and amplitudes**
- **The next step is to use multiple reflections as well**
- **In addition, significant progress is on the horizon if we innovate our data acquisition methods. Incoherent shooting is such an innovation.**

**If we invest in all these promising new developments, the seismic future looks very bright!**