THE MARMOUSI WORKSHOP: INTRODUCTION

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Problems of seismic imaging in complex structures

One major interest in seismic exploration for oil is to get the ability to correctly identify and localize subsurface structures. This is understandable as inaccurate geometrical description of the geological structure is known as the main cause of failure both in exploration and in reservoir development.

It is admitted that, in general, the more complex the structure, the more inaccurate and unreliable the seismic imaging will be; specifically, imaging difficulties do arise in situations involving important lateral velocity variations.

It is accepted that conventional seismic processing can not adequately overcome these difficulties and that tools like inversion or prestack depth migration should be used. Whereas seismic inversion in the case of complex structures is still in the experimental phase, a tremendous effort has been spent on prestack depth migration, as presented by Berkhout (1985), Claerbout (1985) and Stolt and Benson (1986) and several implementations have been developed and are available.

All prestack depth migration methods face the problem that in order to perform correctly they need a correct velocity model. Obtaining this correct velocity model is a non trivial operation, which gets increasingly difficult with an increase of complexity of the structure.

Much work has been done on the recovery of the velocity model either as part of the migration process (Al-Yahya 1987), (Cox et al. 1988), (Denelle et al. 1986), (Faye and Jeannot 1986), (van Trier 1990), (Yilmaz and Chambers 1984) and (Zuurbier and Marschall 1989) or directly from the seismic data (de Bazelaire 1988), (de Bazelaire and Thore 1989) and (Bishop et al. 1985).

A blind test experiment ...

So, many different approaches exist. But it is very hard to compare methods, because different methods are usually tested on different data, and also because the answer which should be obtained is not known — we never can say how "good" our image is.

Thus, the interest of a comparison, where several approaches are tested on the same data and where the correct answer is known is clear.

This led to the idea of a workshop in which participants would compare their inversion and prestack depth migration methods on a synthetic data set without knowing the answer.

This idea was behind organizing the workshop on "Practical aspects of seismic data inversion" (on which these proceedings report) held at the 52nd EAEG meeting in Copenhagen. This workshop devoted to structural inversion was in fact a follow up of a similar workshop (devoted to stratigraphic

inversion) held at the 51st EAEG meeting in Berlin (Grau 1989).

As the aim was to allow comparisons of the solutions with a known answer we took the decision of using synthetic data. We voluntarily restricted the seismic data to being 2D acoustic. We thus eliminated scapegoats such as P to S conversions and 3D effects which are often blamed for the failures of the imaging process.

Apart from this limitation our aim was to have a data set which was as realistic as possible so that we could hope to obtain insights about the possibilities of the methods in a real situation where the answer is not known. Still, the data are synthetic, thus care should be taken on the transposition of the results of the Marmousi workshop to the real world.

The participants

We invited universities, research institutes, contractors and oil companies to participate in the workshop. Eight of the thirty-one invited participated.

Apart from these participants also two speakers from industry were invited to give their view on inversion and prestack migration.

Those accepting our invitation were given a tape with seismic data and a concise description of the geological history of the model and from this they were challenged to produce the best (= most correct) image possible. For a description of the data and the model we refer to Bourgeois et al. (1991) (this volume).

It is interesting to note that the reasons invoked by those who declined to participate ranged between "no time", "not interested", "too difficult", and "I want to protect my know how"....

The day of the workshop

The workshop took place on Wednesday 30 May 1990, as part of the 52nd EAEG meeting in Copenhagen. The participants were handed the structural model, the velocity model and transparencies with the main structural elements and velocity logs at

the beginning of the workshop so that they could compare their results with these.

The program of the day was the following:

- Introduction (P. Lailly - F. Rocca - R. Versteeg)
- Marmousi data and model (R. Versteeg)
- W. Wiggins (Western Geophysical)
- F. Audebert (CGG)
- R. Marschall (Prakla)
- G. Blacquire (Delft Geophysical)
- H. Cox & D. Verschuur (Delft University)
- M. Noble (Institut de Physique du Globe)
- W. Symes (Rice University)
- R. Baumel (Conoco)
- M. Barut (Elf)
- J. Johnsson (Amoco)
- Final discussion

The participants (universities, contractors and oil companies) represented three different points of view. This provided a large diversity in the way the problem was considered and ensured a coverage of the state of the art.

The discussion was a constructive one: participants indicated how far they could go, and where their methods broke down. The discussions between attendants and participants thus centered on problems and how to solve them more than on how "good" one result was, as compared to another.

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