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Contact

Niedersächsische Staats- und Universitätsbibliothek Göttingen
Georg-August-Universität Göttingen
Platz der Göttinger Sieben 1
37073 Göttingen
Germany
Email: gdz@sub.uni-goettingen.de

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Prefaces

The International School of Applied Geophysics was established in 1974. Since then four courses and three short seminars have been organized. The subjects covered several aspects of geophysics, both from the theoretical and the experimental point of view. The topics were selected according to new developments of the geophysical science, but also considering the needs of the users. In every course the theoretical treatment is always accompanied by a discussion on the applications. The title of the 1984 course sounds theoretical; however, the word *use* that is added to the title indicates the practical implications of the subject.

It is well known that synthetic seismograms have been used successfully for more than 20 years in data interpretation of the near-to-vertical reflection seismic technique. The generalization of the approach to the case of variable angle of incidence and of different types of sources was a difficult and long process. It was prompted by the following reasons:

– The increasing interest in defining the source and, in general, the increasingly quantitative approach in *passive seismology*, following the development of digital techniques that was much slower in this field than in the field of oil exploration.

– In *active seismology*, the expanding field of application from sedimentary basins to the upper and lower crust; this expansion led to the need for integration of the normal-incidence and wide-angle reflection techniques.

For the first time, a Director of the Course had been appointed: the subject itself required a specialist to organize the details of the scientific program.

Owing to the original character of most of the lectures, it was decided to accept the kind offer of the "Journal of Geophysics" in order to ensure accurate scientific editing and a proper dissemination among the geophysical community.

R. Cassinis
(Director of the School)

The course "Synthetic seismograms: generation and use" covered problems which are relevant both to general seismology – like the investigation of the lithosphere or seismic source studies – and to exploration techniques for hydrocarbons and other natural resources. Emphasis was given to the different approaches of synthetic-seismogram generation through a review of most of the classical methods currently in use both for laterally homogeneous and laterally heterogeneous media. Several of the papers of these proceedings are review papers; we hope that their joint publication will make this volume attractive both to students entering the field of theoretical seismology and to those considering themselves experts. In addition, some other papers present new results of the application of synthetic seismograms to the structure of the earth and to the earthquake focus.

A round-table discussion was held on the last day of the course; the most relevant topics discussed were instrument calibration, test of methods for laterally varying media and data inversion. The following summarizes a few of the views that were expressed.

Instrument calibration, even if it may look a simple task, is not always done with the precision required for proper use of the available theoretical tools. The most viable solution seems to be to bring all the instruments on the same spot before each campaign and to calibrate them with the same shot. The instrument-ground coupling will enter this calibration; however, it can be observed that the same problem also exists in the actual field measurements along with the little-understood effects of near-surface geology. A systematic study of these influences on amplitudes and phases and of the associated errors is a pressing problem for establishing confidence in results obtained from the comparison of data with synthetic seismograms. The level reached by the theoretical tools is so high that the problem of calibrating instruments should not be postponed any longer, also in view of the possibilities of using explosion seismology data for Q determinations.

A basic problem in the calculation of synthetic seismograms is the testing of approximate methods for laterally varying media, since it may well be that the differences between synthetics calculated with different techniques are larger than those between experimental and synthetic seismograms. One way to proceed here seems to be in the construction of test models using the finite-difference method. For this, it is necessary that the model has linear dimensions of about 100 wavelengths; this requires very large computers.

The interpretation of real data, taking into account lateral variations, should be performed using partially automatic methods. The basic iterative step may consist in the automatic solution of the kinematic inverse problem. For the solution of this problem for 2-D laterally varying media, it is necessary to know the travel times from any point to any other point along the profiles. Therefore, a dense system of shot points is necessary in addition to a dense system of receivers. Several approaches have been proposed recently to solve this problem; most of them are based on linearization. At each iterative step, synthetic seismograms should be used for comparison with observed records. A fast way to find a model for laterally varying media can be the use of dynamic ray-tracing.

As the editors of this special volume of Journal of Geophysics we are grateful to the authors for their cooperation which allowed fast publication.

G. Müller

G.F. Panza
(Director of the Course)