

Kontinentales Tiefbohrprogramm der Bundesrepublik Deutschland

Integrated Interpretation of Borehole Gravity Measurements using Databases

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INTRODUCTION

BOREHOLE GRAVITY IS A RECENT EXTENSION OF CONVENTIONAL SURFACE GRAVITY TO THE THIRD DIMENSION, TO DERIVE A THREE-DIMENSIONAL DENSITY DISTRIBUTION IN THE BOREHOLE VICINITY, WE HAVE DEVELOPED AN INTERACTIVE PROGRAM PACKAGE FOR THE INTEGRATED INTERPRETATION OF BOREHOLE GRAVITY DATA, INCORPORATING ADDITIONAL INFORMATION, I.E. :

- STRUCTURAL MODEL FROM SEISMIC
- DENSITY PROFILE CLOSE TO WELL FROM GAMMA-GAMMA-LOG
- A PRIORI DATA FOR INVERSION FROM CORRELATION STUDIES

INTERACTIVE MODELLING

INFORMATION FROM SEISMIC IS USED TO DEFINE A MODEL GEOMETRY WHICH CONSISTS OF DIGITIZED VERTICAL SECTIONS. THESE SECTIONS ARE DISPLAYED BY THE APPLICATION PROGRAM ON A GRAPHIC SCREEN AND THE USER CAN INTERACTIVELY MODIFY THE MODEL GEOMETRY VIA AN INPUT DEVICE (MOUSE, DIGITIZER) SELECTING DIFFERENT OPTIONS FROM A MENU TABLE. FIGURE 1 SHOWS A SNAPSHOT OF SUCH AN INTERACTIVE MODELLING.

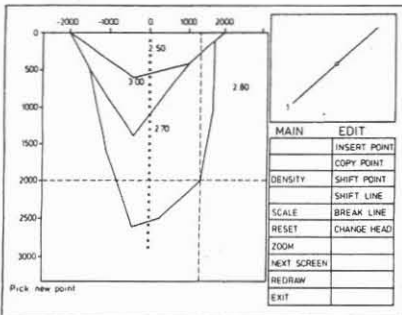


Fig. 1 Example for interactive modelling : Shifting of a corner.

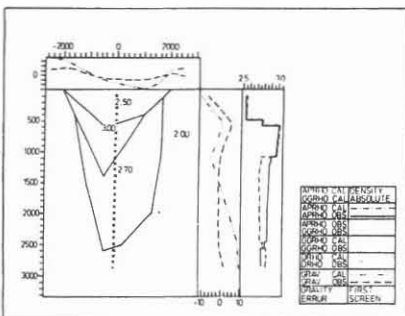


Fig. 2 Display of results after inversion or forward calculation.

THE SECTION DATABASE

IN THE FIRST VERSION OF THE MODELLING PROGRAM, EACH VERTICAL SECTION WAS STORED IN DIFFERENT CONVENTIONAL DATA FILES, WITH INCREASING NUMBER OF SECTIONS, SUCH A DATA ORGANIZATION BECAME UNPRACTICAL AS THE NUMBER OF QUERIES AND SEARCH OPERATIONS INCREASED RAPIDLY IN THE MODELLING PROCESS. CONSEQUENTLY WE HAVE DEVELOPED THE DATABASE SEDABA (SECTION DATA BASE) FOR THE MANAGEMENT OF VERTICAL SECTIONS. BEING VERY FLEXIBLE, THE DATABASE CONCEPT CAN ALSO BE USED BY OTHER APPLICATION PROGRAMS WHICH REQUIRE VERTICAL SECTIONS AS INPUT DATA.

THE DATABASE FOR CORRELATION STUDIES

THE DATABASE DABACOS (DATA BASE FOR CORRELATION STUDIES) WAS ORIGINALLY DESIGNED FOR CORRELATION STUDIES BETWEEN DIFFERENT ROCK PARAMETERS, ESPECIALLY FOR DENSITY-VELOCITY RELATIONS. IT'S CURRENT VERSION CONTAINS MORE THAN 2700 DATA ABOUT CRYSTALLINE ROCKS, I.E. :

- PHYSICAL PARAMETERS (DENSITY, SEISMIC VELOCITY, PRESSURE, TEMPERATURE, ELECTRIC CONDUCTIVITY ETC.)
- ROCK PARAMETERS (POROSITY, HYDRAULIC PERMEABILITY, CHEMICAL AND MODAL COMPOSITION ETC.)
- ROCK CLASSIFICATION (TYPE : METAMORPHITE, VULCANITE...) (GROUP : GNEISS, GRANITE...) (LOCATION, SPECIFIC NAME ETC.)
- ADDITIONAL INFORMATION (AGE OF SAMPLE, MEASURING ERRORS, MEASURING METHOD ETC.)
- SOURCE REFERENCES

THE DATABASE CONCEPT IS SHOWN IN FIGURE 3.

DABACOS - DATA BASE STRUCTURE

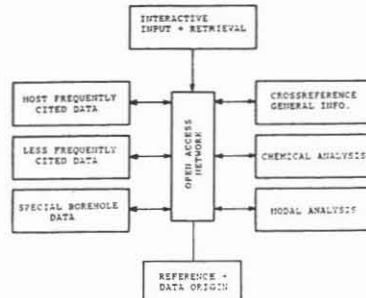


Fig. 3 Structure of DABACOS. Six tables are linked by a network. Data input and manipulation is done interactively.

FIGURE 4 AND 5 SHOW SOME EXAMPLES OF DENSITY-VELOCITY CORRELATIONS DEVELOPED WITH DABACOS.

CRYSTALLINE ROCKS(20-30 °C, 50 MPa)

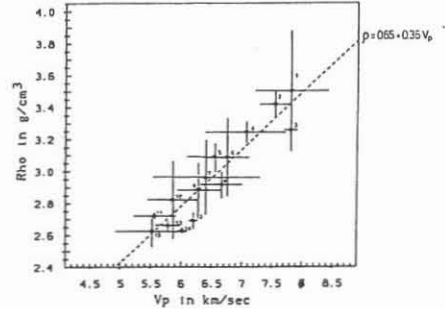


Fig. 4 Mean density values versus mean velocity values for crystalline rocks at 50 MPa pressure and 20-30 °C temperature. The dotted line is the least-squares regression line.

Kristall.Gesteine(20-30 °C, bis 1 MPa)

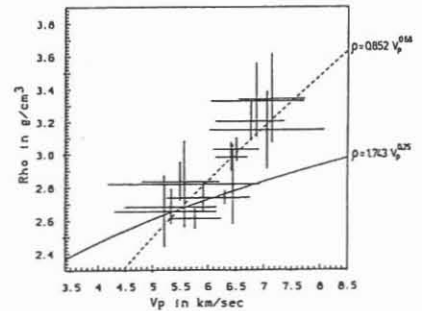


Fig. 5 Mean density values versus mean velocity values for crystalline rocks at 1 MPa pressure and 20-30 °C temperature. The solid curve represents the classical Gardner formula for sediments. The dotted line is a formula for crystalline rocks based on the Gardner approach but with different coefficients.

Kristall.Gesteine(20-30 °C, 50 MPa)

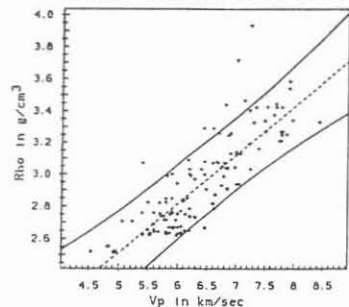


Fig. 6 Mean density values versus mean velocity values for crystalline rocks at 50 MPa pressure and 20-30 °C temperature. The solid curves represent the 95% confidence limit of the regression line (dotted). This information is used to define a priori data for the inversion of the borehole gravity measurements.