Seismic wave velocities in the sedimentary cover of Poland - borehole data compilation Marcin POLKOWSKI and Marek GRAD

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ABSTRACT

A knowledge of seismic wave velocities in the sedimentary cover is of great importance for interpreting reflection and refraction seismic data, deep seismic soundings and regional and global seismic tomography. This is particularly true for regions characterized by significant thicknesses and a complex sedimentary cover structure. This paper presents the results of an analysis of seismic P-wave velocities in the sedimentary cover of Poland, a complex area of juxtaposition of major tectonic units: the Precambrian East European Craton, the Palaeozoic Platform of Central and Western Europe, and the Alpine orogen represented by the Carpathian Mountains. Based on vertical seismic profiling data from 1188 boreholes, the dependence of velocity versus depth was determined for regional geological units and for successions from the Tertiary and Quaternary to the Cambrian. The data have been approximated by polynomials, and velocity-depth formulas are given down to 6000 m depth. The velocities in the sedimentary cover have been compared with those from other areas in Europe.

STUDY AREA & DATA STATISTICS





GEOLOGICAL PERIODS

(a) The study area (yellow frame) on the background of the main tectonic units of Central Europe. BM – Bohemian Massif, Carp – Carpathians, EEC – East European Craton, PP – Palaeozoic Platform, TESZ – Trans-European Suture Zone; (b) Location map of boreholes used in this study on the background of the geological division of Poland, simplified from Sokołowski (1968). A – East European Craton; B – Lowland: B1 – marginal synclinorium, B2 – Pomorze-Kujawy anticlinorium, B3 - Szczecin-Łódź synclinorium, B4 northern fore-Sudetic monocline; C – Folded area: Ca – Sudetes and fore-Sudetic block, Cb – Upper Silesian block, Cc – southern fore-Sudetic monocline, Cd – Miechów synclinorium, Goleniów anticlinorium, Holy Cross anticlinorium; Ce – San elevation, Cf – Lublin synclinorium; D – Carpathians: Da – Outer Carpathians, Db – Silesian unit, Dc – Magura unit and Inner Carpathians. The red dot in SE Poland shows the location of the deepest well Kuźmina 1 borehole, 7541 m. Histogram (c) shows distribution of boreholes amount n with depth z; N = 1188 is a total number of boreholes used in this study.



SUMMARY



(a) Summary of data of P-wave seismic velocities of the sedimentary cover measured in boreholes in Poland. The data were sampled with 1 m depth and the map shows the number of points in the depth interval of 50 m and the velocity interval of 50 m/s. The total number of points is about 2.3 million, which corresponds to about 2300 km of total length of vertical seismic profiling in boreholes. Colour scale shows a density of data. (b) Our result is compared to other regions: Pannonian Basin (Mészáros and Zilahi-Sebess 2001), Swabian Molasse Basin (John 1956) and Norwegian shelf (Storvoll et al. 2005).

Velocity-depth distribution for the Tertiary–Quaternary for Lowland units: A, B1, B2, B3, B4, Ca, Cc, and Cf; and southern Poland units: Cb, Cd, and Ce. Note different scales of graphs.

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