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Faculty of Geology, Geophysics and Environmetal Protection
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PhD thesis:"*Construction of seismo – geological model of glacial deposits on the selected part of Polish Lowland, based on complex, high resolution seismic measurements".*

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Extended abstract

Chapter 1

Section 1.1 contains the first information and the list of doctoral thesis. It discusses the basic aim of exposed work. At two distinguished planes seismic engineering is considering. Besides aspect multi - methodolical imaging of glacial deposits, work focuses on the use of the results of seismic engineering as a support tool for exploration seismic. Section explains the composition of the thesis. In subsection 1.2 four theses, proof of which was carried out in this trial is exposed. The next section describes the location of the in – field measurements. Section 1.4 presents the outline of the history of imaging glacial till. It describes the evolution of research seismic sediments in application to glacial till imaging. There were listed seismic methodologies used in the discussed aspect over 20 years. Section 1.5 provides an illustration of the concept of the research. It describes the variants of seismic methods taking into consideration as imaging tools for choosen part of Polish Lowland. The idea of join inversion, combined between slected methodologies is highlighted.

Chapter 2

The second chapter presents an geological overview of the area of research. The seismic profile was oriented at the background of regional tectonics and meso – regions of the Zachodniopomorskie Lake District. It includes a brief sketch of the geometry and possible glaci - tectonic deformations of subsurface sediments. It describes the characteristics of glacial sediments with an indication of their characteristics, which are important in the light of the constructed sejsmo - geological model.

Chapter 3

Chapter begins with a description about localization of testing survey area, conducted before main acquisition works. In Section 3.2 were enclosed a typical ways of implementation of in - field layouts geometry in near – surface seismic. There were pointed two basic schemes of measuring geometry in seismic engineering, on the basis of which was developed an Individual geometry model, used during the acquisition work involved reflective seismic method. Description of used equipment includes section 3.3, while subsection 3.4 presents the modifications introduced, allowing for efficient acquisition the information about the glacial till. An asymmetric arrangement of shot points due to fixed receivers layout was applied. This operation allows a zones of fold accumulation, which will have application in later velocity analysis. The configuration of measurement systems was justified by field tests. In a variant of the multichannel analysis of surface waves a continuous profiling scheme was used. The research profile was divided into estimation sections. The acquisition of seismic records used mobile measuring system called "land streamer". A variant of passive seismic measurement was based on linear topology. Both, its receiver layout length and recording time were

fit to the observed seismic microtremors, induced by the presence of measuring equipment and the natural, low frequency fluctuations. Reflective variant as well as passive one were conducted on the basis of permanent positions relative to the spacing profile research.

Chapter 4

Section 4.1 provides a brief description of the variant profiling velocity in the hole. It discusses the velocity distributions, calculated for longitudinal and transverse waves. They pointed out the anomalous behavior of the velocity of shear wave in vertical polarization. The obtained results were schedule calibration variant for multi-channel analysis of surface waves. The analysis of data obtained started from the multi-channel analysis of surface waves. In Section 4.2 presents the theoretical introduction associated with specific features of the surface wave and the discussion of the theoretical basis of the analysis of surface wave. Much attention was paid to the process inversion parametrization MASW what is the content of subsection 4.3. Initial startup solid models made in dependency on the phase velocity (the form of dispersion curve) and the relationship between the velocity of longitudinal and transverse waves in glacial till. The relationship between these constants were supported by direct research results and information from literature. Chapter discusses the modal behavior of the surface wave, indicated the difficulties associated with fluctuations in the recording surface wave phenomena. It introducing the way of picking and analysis of dispersion curves, matched to the characteristics of the acquired data. Section 4.4 presents the results of passive seismic measurements. Lack of legitimacy of their use in the context of increasing the range of penetration method of MASW, was proved. It revealed the presence of noise induced along the measurements layout and pointed the poor quality of the passive dispersion curves. Testing analysis of reflexive records were use as source of information about surface wave data. This analysis is the content of subsection 4.5. On the basis of demonstrated generalization resulting velocity distribution of transverse wave and loss of detail resulting structural velocity model, results mentioned test was deny. Section 4.6 shows the results of the data processing method MASW. It stated that variation of the mean square error suggests a lack of association of its growth from the modal form of the observed phenomenon of surface wave. Its distribution is equated to changes in the internal structure of post - glacial sediments. Section 4.7 provides a summary of part of the results of MASW in comparison to in – hole velocity profiling results.

Chapter 5

Chapter 5 is devoted to the interpretation of the refraction data. Its beginning contains a description of wave refraction and a discussion of the techniques used for its analysis. In subsection 5.2 is the description of the characteristics of the kinematic shapes of refraction wave. Particular attention was focused on the construction of the initial velocity distribution in refraction tomography what is the content of subsection 5.3. The basis for its construction were the results of the multi - channel analysis of surface waves. There was introduced and discussed the concept of static corrections. In the next chapter their values were calculated and discussion was conducted on received distributions of static corrections. In section 5.5 a technique of the azimuthal profiling by the mobile measuring system was exposed. Obtained results were used to estimate the static corrections, as comparison to the in - hole seismic velocity profiling ones. Section 5.6 was calculated a complex, static correction values in application to exploitation seismic.

Chapter 6

The sixth chapter includes an analysis of records in reflective variant. In Section 6.1 and 6.2 contains in order: the

theoretical foundations related to the propagation of the reflected wave and the description of kinematic aspect of the recorded reflected wave. The theme of subsection 6.3 is the removal of coherent noise. The two methods mentioned noise elimination were taking into consideration. They justified their use on the basis of the description of the effects of filtration. They were adopted to use in the application of shallow seismic data. Differential scheme are used in the filtration F - K method and the radial transform. Bandpass filter in radial technique was fit to the spectral range of the surface wave. Section 6.4 presents the stage of the velocity analysis. As applied to the imaging of glacial developed a two-stage procedure for the determination of the stacking velocity were performed The first stage uses a classic scheme with function cross – coherence Semblance. The analysis was performed in areas along seismic profile with highest fold. Obtained stacking velocity was estimated based on data with applied refractive and tomographic static corrections. Defined field were served for subsequent analysis in accordance with the use of procedures CVS. In next step shallow seismic sums were computed and compared with a part of the prospecting time section. Chapter 6.5 discusses the special features of the obtained results, depending on the static solutions previously applied to the stacked data. The last section contains the proposed procedure for processing subsurface reflection data shallow area of the Polish Lowlands.

Chapter 7

The construction of the sejsmo – geological model was started from the section discussing the deforming impact on the ice sheet to underlying till. It includes a simplified diagram of propagation of the glacier mass with possible deformations in its immediate vicinity. Successively subsection 7.2 presents the concept model sejsmo - geological and sejsmo - facies. The present section is a study of the literature concerning the interpretation sejsmo - facies and the possibility of their use. In section 7.3 detailed geological information about the area of research and the results of borehole were collected. They create a database of information needed to take the discussion in section 7.4. The depth conversion step temporarily started by pointing out the characteristics of the velocity field, which was used to calculate the deposition reflective horizons. We summarize the results of the estimation of depth seismic reflection data with existing geological model and mouthed, obtained from the documentation sheet Nadarzyce. Time section after depth conversion was correlated with the results of refraction tomography and multi-channel analysis of surface waves. Due to the difficulties in interpretation, schema of construction was divided into two stages. In the first analyzed data to a depth of 30 meters. It was dictated by the diversity of obtained velocity distributions as well as the complication of internal complications of shallowest zone of glacial till. Reported discrepancies between the hole and the geological interpretation of the results obtained from velocity profiles were used to develop individual path analysis results. The values of the velocity field longitudinal and transverse waves were linked together in function of Poisson's ratio and the quotient of the velocity of the longitudinal to transverse wave. They are an indicator of geo - mechanical - measure of brevity ground and hydrogeological - determining the degree of saturation unconsolidated material. On the two maps were carried out interpretation of the geophysical boundaries of the depth domain. On the basis outlined the physical properties of the imaged material on both maps and then compiled them into one collective model. It has been shown the existence of the saturated zones is observed as suspended bodies, whose existence is justified in the presence of sealing layers - clay. On this basis the continuation of layers of clay, which first deformation zone of the created model. At the initial stage of interpreting a very important step was to find a reference horizon, which corresponds to the pseudo – substrate reflecting horizon present on the received velocity maps. According to the conversion process is the reflecting layer at the time of 38 msec. It bores a hole at a depth of about 29 meters. When all the results were in a uniform domain of depth, an analysis of reflection horizons were perform. The basic criterion for determining the

boundaries is the convergence of the depth of the reflective layer with established geological data. Secondly sum compared with the patterns seismo – facies. The resulting model has interrupted the continuity of layers, so their tracking in its entirety part of research profile was not possible. In this case interpretation were supported by the similarities phase seismic boundaries and characteristics of the kinematic patterns seismo - facies. As a result of these actions, a hybrid, seismo - glacial geological model was constructed. Section 7.5 provides an illustration of the glaci – tectonic model. It was distinguished into three types of deformation. First, shallow area, characterized by strong plastic deformation layers, embedded in the sands and gravels. The second intermediate folded, characterized by structure large amplitude and rupture of layers. Third, related to a layers covering jurasic bedrock. It contains imbrication structures. In central part of glaci – tectonic model a anticlinal deformation is observable. Presenting area is a zone of stress cumulation.

Chapter 8

In the final part of the thesis a set of conclusions is presented. It outlines the possibility of using the received results and shows one of the possible ways to use the exposed models in terms of exploitation research. Chapter indicates the future way the development of high resolution imaging of glacial sediments.

Chapter 9

The ninth chapter contains acknowledgments.