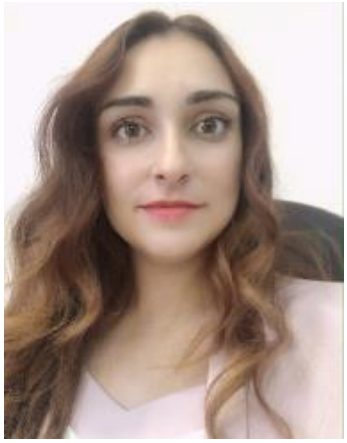
Novosibirsk State University
*THE REAL SCIENCE

GEOLOGICAL INTERPRETATION OF GEOPHYSICAL DATA



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Research Interests: Seismogeologic modeling of oil and gas fields and assessing the oil and gas potential in the northern regions of the West Siberian oil and gas province.

Course Goal

To teach students the complex interpretation of seismic and well data in order to build a model of hydrocarbon traps and fields using modern software. Currently, seismic exploration is an integral part of geological and geophysical research in the search and exploration of hydrocarbon deposits. It is important for geologists to understand the basics of the CDP-seismic method, be able to work with and interpret data, build structural maps and thickness maps of target horizons, know methods for constructing effective thickness maps, build a model of a trap or field, outline more promising zones for searching for oil or gas - traps or perspective objects. At the end of the course, students will have mastered the skills of building a model of a hydrocarbon field, determining parameters for calculating reserves, and estimating resources using the volumetric method. The course helps provide an understanding of how models are built, what input data is needed, and teaches the students how to work with data and analyze the results.

Topic 1: Seismic Basics

Section 1.1. **Fundamentals of Wave Physics**
Waves in absolutely elastic media.
Absolutely elastic medium (Hooke's Law).
Wave characteristics: length, frequency, period, speed.
Wave types: longitudinal and transverse. Spherical waves. Plane waves.

Front of the wave. Fresnel zone. Huygens-Fresnel principle. Fermat's principle.
Wave propagation in absorbing media.

Section 1.2. **Seismic Waves in Heterogeneous Media**
Reflection and transmission of a plane wave.
Reflection and transmission of a spherical wave.
Curvilinear borders. Diffraction.
Environments with multiple boundaries. Multiple waves. Interference.
Multi-layered environment.

Section 1.3. **Seismic Waves and Seismic Survey Methods.**
Elastic waves in rocks. Seismic wave velocities in various rocks. Influence of fluid on the speed of seismic waves. Variation of speeds with depth.
Seismic boundaries.
Reflective and refractive border. Low speed zone.
Acoustic and shear impedance.
Excitation of elastic waves: explosive and non-explosive sources, vibration and pneumatic, electrospark.
Seismic survey methods: RSS, CDP, SK, VSP, AK; land and sea; 1D, 2D, 3D, 4D.

Topic 2: Fundamentals of Integrated Interpretation of Geological and Geophysical Data

Section 2.1. **Receiving and Primary Presentation of Seismic Data Field seismic survey.**
Sources and Receivers. Seismic stations. Observation systems. Hodographs. Seismograms.
Basic concepts of seismic data processing.

Section 2.2. **Practice: Acquaintance with the Object of Study (field) - Handouts**
Section 2.3. Interpretation of Seismic Data
Kinematic and dynamic interpretation.
Section stratification, reflector stratification.
Picking of reflectors.

Section 2.4. **Practice: Stratigraphic Referencing and Picks of IIa , III, IV, V Reflectors by Different Pick Types (Manual, Semi-automatic and Automatic).**

Section 2.5. **Interpretation of Seismic Data**
Identification of faults in CDP surveys.
Practice: picking the fault.

Section 2.6. **Interpretation of GIS Data**

Types of logging. Interpretation of well logging data - KS, PS, GK, NGK, AK, IK.
Display of various rock lithotypes on log curves.
Lithological dissection of the section according to the logging complex.
Construction of correlation schemes.

Section 2.7. **Interpretation of GIS Data**
Practice: Load the log into the project.
Identification of horizons and units in the interval of Callovian-Tithonian deposits in the study area according to GIS data.
Practice: to identify the Bazhenov, Georgievsk and Vasyugan formations, and identify in the Vasyugan formations the subcarbon, intercoal, and subcoal units in all wells in the study area.
Practice check our correlation, correction, creation of an electronic bank of stratigraphic tops.

Section 2.8. **Description of Core, Cuttings, Test Results and Well Testing**

Section 2.9. **Building a Field Model: Lecture**
Construction of structural maps for reflecting horizons.
Creation of maps of seismic complexes thicknesses.
Construction of effective thickness maps.
Creation of fault diagrams.
Analysis of the constructed maps.
Building forecast maps.

Section 2.10. **Building a Field Model: Practice**

Practice: Building maps of isochrones, velocities, structural and thickness.
Practice: Construction of seismic-geological sections and paleosections.
Practice: Analysis of structural maps - structural characteristics of the study area.
Practice: Analysis of thickness maps - history of tectonic development of the study area.
Practice: mapping the effective thicknesses of productive sandy horizons.
Practice: preparation of well test data, loading them into the project.
Practice: Building a forecast map / maps.
Practice: Writing a report on the work done, preparing a presentation.
Practice: Preparation for project defense.