

GEOSTATISTICS MÓRAHALOM 2011

PROCEEDINGS

THE XIV. CONGRESS OF HUNGARIAN GEOMATHEMATICS and THE III. CONGRESS OF CROATIAN AND HUNGARIAN GEOMATHEMATICS



APPLICATIONS OF GEOSTATISTICS, GIS AND REMOTE SENSING IN THE FIELDS OF GEOSCIENCES AND ENVIRONMENTAL PROTECTION

Publisher	Magyarhoni Földtani Társulat
ISBN	978-963-8221-45-2
Subject Collection	Geostatistics, GIS, Remote Sensing
Date	16 May 2011

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Parameters sensitivity in simulation of seawater intrusion

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Abstract

In many coastal areas, the growth of human settlements, together with the development of agricultural, industrial and tourist activities, has led to the overexploitation of aquifers. Such overexploitation commonly results in a rise in the freshwater–saltwater interface (seawater intrusion) and thus degradation of the chemical quality of groundwater. Under natural conditions, the geometry of the saltwater wedge depends on the hydraulic properties of the aquifer, the physical properties of the two fluids and on aquifer geometry. In this paper we are only discussing influence of the changes of hydraulic properties of the aquifer on seawater intrusion's velocity and extend by harnessing numeric solutions.

We have used SEAWAT software for modeling, and according to the results we can confirm that the influence of hydraulic properties could be divided into two groups, in first one (effective porosity, specific storage, specific yield) the velocity of intrusion directly changes with the altering of these parameters, while in the second group (hydraulic conductivity, longitudinal dispersivity) this relation was inversely.

Köröstarcsa Reservoir Model based on Truncated Gaussian Simulation Technique

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Keywords: 3D modelling, Truncated Gaussian Simulation, Sequential Gaussian Simulation

Abstract

The Köröstarcsa gas-condensate field, located in the Southern Great Plain of Hungary, has been discovered in the 1970s. The intersected reservoir rocks have been classified as Triassic and Miocene in age and are considered to be part of the Villány-Bihar Subunit, inside the Tisza Unit.

The generation of a realistic, static model was a challenging task. The modelled stratigraphic interval consisted out of seven facies, including three distinct reservoir rocks (Lower Triassic sandstone, Miocene clastics and Badenian biogenic limestone). It has been considered that the facies have been deposited during two distinct retrogradational cycles, separated by a major discordance. Furthermore, complicated reverse fault tectonics and subsidence heavily affected the Köröstarcsa environment and made a paleo-reconstruction difficult.

The limited input data (six wells, 2D seismic interpretation and few core samples) in combination with the geological understanding of the area of interest have been used to create a facies model. The Triassic and Miocene were separated in two distinct depositional systems and their corresponding facies have been simulated on the base of Truncation Gaussian Simulation. This technique enabled to reproduce the described stratigraphic environment in a realistic way and served as the main driver for the reservoir parameter population.

In order to get a better understanding of the reservoir, the rock porosity and permeability needed to be simulated based on a Sequential Gaussian Simulation technique. A careful conducted data analysis exposed and significant under sampling of the reservoir. Therefore, the limited well data forced the geologist to neglect areal and geological trends and provoked the artificial compensation of the residual's probability density functions. The correct distribution of the parameter could finally be guaranteed by conditioning the resulting static model to the available well data as well as biasing it to the predefined facies model.

Statistical Analysis of Neogene Sediment Thickness Deposited in 1st Transtension and 1st Transpression, Bjelovar Subdepression, Croatia

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Abstract

Bjelovar Subdepression is situated in the eastern part of Central Croatian and represents the south-western branch of the Drava Depression. Neogene-Quaternary sequence can be divided into three sedimentary megacycles, which are separated by the regional unconformity (VELIĆ et al. 2002; VELIĆ, 2007). Development of Croatian part of the Pannonian Basin is described in many papers, e.g. TARI, 1994, CSONTOS et al., 2002, SAFTIĆ et al., 2003. Analyzed data belong to the 1st megacycles, marked by tectonic-erosional unconformity in the basement of Neogene (e-border "Pt" or "Tg"). Furthermore, regional e-log marker Rs7 (deposited at the end of 1st transtension) separates Sarmatian and Pannonian sediments. The youngest e-log marker Rs5 represents top of lower Pannonian and beginning of 2nd transtension. Both of them belong to 2nd megacycle. Analysed intervals belong to 1st (Badenian-Sarmatian) and 2nd (Lower Pannonian). Lithology of Lower and Middle Badenian is coarse and medium grained sediments, in opposite to Upper Badenian to Lower Pannonian pelites as result of shallowing and salinity reduction. Statistically are analysed thickness maps for intervals RS5-Rs7 and Rs7-Pt/Tg (maps after Malvić, 2003). This analysis had been based on regular grid divided in nodes (500x500 m). Assumption is the 1st transpression reflected in shallowing and changing the thickness of sediments. Compared intervals are different duration (3.4 Ma Badenian and 1.5 Ma Sarmatian, 2.2 Ma L. Pannonian). Calculated histograms, averages and classes confirmed assumption that these two phases can be clearly distinguished by statistical analysis of thickness.

Problems and solutions of a well-pair near Szentés

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Abstract

Szentés is located in Middle-Hungary, in the so-called Tiszántúl region of the Great Hungarian Plain. In this area, there is the largest Hungarian geothermal system owned by Árpád-Agrár Plc.. This system uses 60–95 °C water for heating greenhouses. There are 20 thermal wells with 2.000 meters of deep in average.

The wells have been perforated to the Újfalui Formation of Upper-Pannonian (5,4–2,4 Ma) age. The characteristic rock types of this formation are sandstone, aleurolites and clay marls developed in deltafront, delta plain sequences. Hydrogeologically this formation is one of the most important ones of this region. With its 1000 md average permeability, it is a part of Great Plain Aquifer.

Because the most perspective natural resources of Hungary are the water and geothermal energy it is essential to understand the natural processes commanding them, and their reactions to 50 years term water extraction.

Since the use of deep thermal waters last for about 50 years in Szentés, it was a great chance to observe changes in the hydraulic properties. As a part of National Technology Program the wells of the region were tested with geophysical and pumping-test methods.

The main goals of our work are to present such empirical és theoretical geomathematical-hydrogeological methods, which can be used to understand the connectivity problems of a production-observing well-pair with a limited number of information available.

We had pressure, and temperature measurements in addition to well-logs and production data. Aquifertest was used to test the different methods of recovery intervals of the pulsing tests.

Comparisons of Theis', Hantush's, Theis with Jacob's, Neuman's and Cooper-Jacob's methods resulted in the most reliable model solution. In this way we were able to study the two wells both separately and together for understanding the background of the observed delay and missing of generated signal between the production and observation well.

Based on these results we were able to characterize the aquifer, compare our calculated results with those of literature, and see the changes compared to the natural state.

Calibration of monitoring networks

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Abstract

To investigate the effects of both natural incidents and human activities are monitored by appropriate networks. The design of these networks mostly carried out by proper analogy. These monitoring networks have to be calibrated and adjusted to the local conditions. Just like the design, the calibration of these networks can be done by geostatistical methods. The study intend to introduce such geostatistical methods on a single measuring station with one measuring line and a single measuring network.

Analysis of the climate and vegetation changes in the Great Hungarian Plain 2000- 2009

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Abstract

Remote sensing provides appropriate methods to monitor changes of vegetation. We can derive vegetation indices from satellite images (such as EVI or NDVI) to estimate the current state of the biomass production. Best way of detection is using low-resolution data. Imagery of MODIS provide us composites of daily data filtering noise of single records.

Detecting the changes of precipitation and ground water level is also an important aspect of the analysis. These two factors can determine the state of vegetation, it is evident that better conditions of water supply leads to an increased amount of biomass production.

The study area of the survey was in the Great Hungarian Plain, between river Tisza and the Danube. Because of its specific relief, the water resources are isolated and there is no possibility of supply from higher regions.

In my research I was looking for a quantifiable connection that could be defined between the hydrometeorological parameters and the index values. Identifying this correlation can help us understanding the aridification processes and it can give us the possibility to predict further vegetation changes in this region.

Application of geographical information system in analysis of stratigraphical unit thickness — A case study of Basic Geological Map of Croatia

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Keywords: Basic Geological Map, Croatia, GIS, stratigraphy, interpolation

Abstract

Basic Geologic Map of the Republic Croatia at the scale of 1:100 000 consists of 74 sheets. More than seventy mapping geologists, large number of specialists and numerous technical support staff in various geological disciplines, have participated in map production over a period of 27 years. Map is based on the chronostratigraphical classification (series, systems and eras) except in cases where it was not possible, so more general units have been used. Each sheet consists of schematic geological column showing thickness of mapped units. Thicknesses of each stratigraphical unit were analysed and after that thickness values were stored in the attribute tables of relevant features in the GIS point feature dataset. For each stratigraphical unit specific feature dataset has been created. Each sheet is represented by centroid that contains thickness value of the stratigraphical unit on that sheet. Processing and presentation of the geospatial data was done using GIS software, utilising additional spatial and geostatistical extensions. Analysed data were interpolated by deterministic method – spline interpolation, which provided the best results in this case. After the input data were interpolated in raster grid format, relevant equidistance and colour were chosen for interpretation of each single raster. The results were presented by a series of maps within a GIS project that consists of a total of 35 maps: 18 based on series and 17 maps that comprise of stratigraphical units combined on basis of systems and eras. Maps show thickness of the stratigraphic units and their spatial distribution over the territory of the Republic of Croatia, based on the chronostratigraphical units (series, systems and eras). Such graphical display clearly shows the areas with the highest and lowest thickness of stratigraphic units, the trends of increases and decreases the thickness and the dynamics of sedimentary basin areas.

Hungarian Expert Database of Thermal Energy

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Keywords: database, geothermal, GIS, web, hungary

Abstract

Our general aim is to get a professional database available on abandoned non-productive and productive geothermal wells in Hungary. These data can be effectively used to create and run local, regional and synoptic hydrodynamic and heat transport models and moreover to put view on the GIS-based statistical analysis of recovered information. For the first step an SQL database model was made that integrates in one structure all data series of fountain cadasters and protocols in the country. Accordingly, every pump has 48 basic parameters in direct or indirect logical relation with each other in 5 parameter groups (general data, lithologic data, thermal water data, measurement data, technical data). The parameters are infinitely expandable. Groups of Parameters General data are: date of drilling, name, number, cadaster number, pedestal deepness, geographical coordinates, altitudes (mBf, mAf) and the name of the source of applied data. As lithological data we defined: layer age, layer lithology, bedrock and thermal conductivity. Thermal water data are: fountain type, water deepness, temperature, flow and date of measurements. Measurement data contain: water chemical properties, pressure elevation data, gas test, permeability, leakage, porosity and other geophysical data. Technical data are mostly indicative and consist of tube properties, for e.g. perforation values. Most data for the work reported in this paper were provided by György Gruber and by Hungarian Thermal Well Register. The project was financially supported by the Hungarian National Technology Program (No. TECH 08 A4 DA THERM), and (No. DA HALO 06/007 GEOTERMA).

English-Hungarian Electronic Geophysical Thesaurus — Opened for public use on the internet portal <http://kinga.elgi.hu> as from Easter#1

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*Keywords: geophysical thesaurus, vocabulary, database, internet, remote editing,
encyclopedia, hierarchy, datamodel, grammatic review*

Abstract

The mission of ELGI, as it is being state owned institution, doubtlessly includes such kind of services in the geophysics, which are inherently related to long term objectives. The development of the English-Hungarian Electronic Geophysical Thesaurus (spelled as AMEGA in Hungarian acronym) was considered to be a similar case. Such a collection of English geophysical terms, has been awaited by the domestic professionals for a long time. The financial background and a well articulated professional demand for the development of AMEGA had been provided by the GEOMIND and KINGA projects, coo-financed by the EU Framework Programme-7 and inland cohesion sources. One of principal issues of the GEOMIND project is just a seamless dissemination of geophysical information in a multilingual environment on the internet. The structure of the database and the user interface of the thesaurus is constructed in such a way to be capable of handling not only two current languages (English and Hungarian), but a multilingual content. During the development of the system such elements were built in, which are presently not used, however, they create the possibility for accomplishing some more complex encyclopaedic functions than a pure lexical search. Besides the interactive service, including the technical base of future enhancements, the fundamental objective of the AMEGA is providing an internet-based, professionally and linguistically authentic English-Hungarian thesaurus of special terms for the domestic geophysical community. The AMEGA, acting as a public internet service is expected to be beneficial for users of many areas. They might be students, geophysicists, participants of international cooperations, or private international geophysical companies, seeking business in Hungary. We encourage all potential users to use this brand-new internet service of the ELGI as frequent as possible, to conceive their suggestions and demands, in order to facilitate the future enhancements.

Application of multi variate data analysis methods on the datasets of the Aggtelek Karst's caves (NE Hungary)

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Keywords: observation wells, multi variant statistical methods, water system

Abstract

Water was observed in the sediments of the Baradla and Béke Caves, located in Northeast Hungary. In order to investigate its characteristics observation wells were drilled. Hydrochemical analyses were conducted on samples taken directly from the wells and from caves' creeks and springs on the surface on several occasions. Water samples differentiated into calcium-magnesium-bicarbonate hydrochemical facies, as had been expected. The monitoring of the hydrochemical parameters started in November 2009 and finished in April 2010. Thanks to the favorably chosen period, there was an opportunity to observe if, and how the chemical content of the creeks and sediment's water changed during the snow melting. In the wells settled in the Baradla Cave's sediment, water level values increased after one week. They fill up with water whenever a flood occurs and their chemical characteristics do not change even after the flood. The main ingredient of the caves' sediment is quartz, so dissolution is minimal due to the stone-water interaction. In the Béke Cave's observation well, water level fluctuation was not noticeable. Primary karst dissolution is the process that determines the chemical characteristics of caves' creeks and springs. The chemical parameters of the water in the cave-sediments, creeks and springs were studied spatially and temporally using multi variant statistical methods. Based on the results of the hydrochemical analyses cluster analysis was applied to define the relationship between the sampling points. To verify the classification discriminant analysis was conducted. As a result of the classification, the water in the observation wells, located in the sediment, separated from the caves' creeks and the springs on the surface. The results were compared to the archive measurement results from 1980-1983 and 2003-2005.

Classification of remote sensing images using self-organizing neural networks

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Keywords: Neural network, self-organizing map, multispectral classification, texture analysis, grey level co-occurrence matrices method, urban land cover

Abstract

In our study we were investigating the application of an unsupervised neural network model, the self-organizing map (SOM) to identify urban land cover classes using a multispectral IKONOS image. Artificial neural networks are information processing systems composed of many simple, weighted connected processing units (neurons), which are organized into layers. Their structure and working principle is based on biological neural networks. The self-organizing map (SOM) model is capable of mapping large, high-dimensional datasets into lower dimensional data spaces. It can also identify homogenous clusters in a dataset, and therefore can be used for classifying multispectral satellite images. We carried out the classification of the IKONOS multispectral image to obtain land cover classes in a selected urban zone in Szeged, Hungary. In order to improve the quality of the land cover classification, in addition to the four spectral bands, texture features were extracted from the image and used as an input. The texture features were created using the grey level co-occurrence matrices (GLCM) method, which involves construction of matrices containing information about occurrences of image pixels that have similar grey levels and deriving various statistical indicators from them. From the results of the classification we created thematic maps showing the various land cover types. The results of the classification proved that the SOM method can be used as an alternative to conventional classification methods in urban land cover classification.

The role of stochastic view in reservoir characterizations

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Keywords: stochastic simulations, variogram, desclustering, multi-point simulations, reservoir characterization

Abstract

Geostatistics provides a set of statistical tools for incorporating the spatial coordinates of Earth Science observations in data processing, allowing for description and modeling of spatial patterns, prediction at unsampled locations and assessment of the uncertainty attached to these predictions.

Until the late 1980's, geostatistics was essentially viewed as means to describe spatial patterns by semivariograms and to predict the spatial values at unsampled locations by kriging. Later new tools have been developed to tackle advanced problems, such as the assessment of the uncertainty about reservoir quality or soil pollutant concentrations, the stochastic simulation of the spatial distribution of attribute values, and the modeling of space-time processes.

The greater accessibility of geostatistical software has increased the risk that geostatistical tools are used without a good command of the underlying theory. This statement is particularly true in the field of semivariogram modeling and stochastic simulations. In addition, in several situations, inappropriate or non-optimal approaches are adopted because users are unaware of recent developments.

The stability of semivariograms is essential for resulting in meaningful estimation. This stability depends on not only the number of pairs incorporated in the calculation, and the variability of differences, but the redundancies arising from the proximity of neighboring well locations. Omitting any preliminary declustering methods can cause bias results.

In case of stochastic simulations there are several important questions and consequences which used to be omitted. In between the 'leader' is if the results are good or not. In the answer it should be demonstrated that the results are fulfill the original goal, that is, honor the data covariance or/and the starting conditional probability distribution. The next important point-of-view should be if the grid geometry is adequate. That is, the results are controlled by the geological heterogeneity and not the estimation stability. In case of multi-point simulation,

the main problem is to use adequate training images which have been generated to be in harmony with the local geological conditions.
These problems are demonstrated by several 'hot' examples coming from Pannonian reservoirs.

Application of clustering methods for identification of environments, case study in one croatian field, in sava depression

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Abstract

The study area is located in Sava depression, Croatia. The field is composed of Tertiary and Quaternary deposits. Sedimentation was accompanied by reworking of the bottom of sedimentation complex, which is of heterogeneous lithological composition.

There are total 88 wells in the field, but well logging data and analyses available only from 79 wells were used in preparation of the clustering model. This study shows two clustering methodology which can handle simultaneously more point data and even joint more attributes or property of data points. Neural Network process and classical multidimensional method were applied for clustering. The NN method is the Self Organizing Map (SOM). The other process based on hierarchical method with cosine distant. In both clustering models the inputs were the basic petrophysical parameters (porosity, water saturation, shale volume) and a binary variable describing the lithology. This latter one, however, was modified to be a categorical variable with six categories according to the shale content of sandy deposit.

The entire rock body contains 11 reservoir layers of late Miocene sandstones which are grouped into some production units. The series consists of fine-grained quartzose sandstones alternating with marls. In the first step, the model was aimed at vertically averaged parameters of the 11 reservoir layers. (The thickness changes between 120-150m.) The results were quite large scaled ones, that is why we focused this approach only to the two biggest reservoir in the series.

The results are in harmony with the conceptual model of the depositional history. The resulting map demonstrated the main sediment-transport directions, and outlined the main channel and fan geometry. These findings suggested two main axes of sandy transport directions.

Large-scale meteorological field modelling based on geostatistics approaches

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Keywords: Distributed hydrological modelling, interpolation, automatic variogram model fitting, stochastic simulation, uncertainty estimation of interpolation, global optimization.

Abstract

The meteorological data is a key input for any hydrological model because it mainly determines the spatially and temporarily highly-varied volume of water balance components in a catchment, therefore the accurate rainfall and temperature input data in time and space is crucial factor in hydrological modelling. Particularly it is important to know the amount and spatial distribution of precipitation as well as reliable estimation of temperature-field, because these information strongly influence all hydrologic elements and processes, especially the runoff forecast in a catchment, snow accumulation, flood warnings or waste water flow regulation. Climatological data are usually measured at point locations, while it is necessary to know these values everywhere; therefore we have to use a kind of adequate mathematical method for mapping. In distributed hydrological models, spatial interpolation is typically applied to a grid with estimates made for all cells. Spatial interpolation therefore means a kind of conversion of point data to field data so that it can be used together with other spatially distributed data for analysis and modelling. The objective of this study is to present our research results regarding the model-based estimation of large-scale high resolution meteorological fields, which methods are appropriate to evaluate the uncertainty of estimation as well. The focus of the presentation is to present two methods of meteorological field modelling: the Modified Universal Kriging (MUK) for interpolation of temperature, and the so called "KLAM" (Kriging with Local Anisotropy Model) method embedded into a stochastic simulation cycle used for precipitation field modelling.

Lessons Learnt from the Adoption of Open Source GIS for Quality Checking of Hungarian LPIS

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Keywords: Quality Assurance, LPIS, Open Source, QuantumGIS, gvSIG, OSS GIS, performance

Abstract

The Compet-Terra is carrying out QA (Quality Assurance) services at the Hungarian Agriculture and Regional Development Agency. The quality checking of the LPIS is one of the important QA duties. The LPIS data set is updated yearly according to the cycles of the agriculture subsidies. The investigation approach was focused on two sensitive aspects of the update procedure. Regular or regressive errors and historical continuity of the land parcel attributes. Compet-Terra elaborated an Open Source Software based checking method that could be adopted by the client without financial spending on software. QuantumGIS, gvSIG and OpenOffice were used for the quality checking of the LPIS. QGIS was the primary tool, OpenOffice Calc was used to manipulate the data tables and gvSIG was used to check the calculations (when QGIS results were different from the original values). Four primary quality types were checked: (1) the land parcel attributes, (2) the areas of the polygons, (3) the completeness of the content and (4) the topological quality. For these investigations topological GIS functions and database management functions were used. The most important functions were topological difference calculation, polygon area calculation and geometry validity checking. Complex procedures were also completed with proprietary tools to compare the results and the running times. The result of the adoption of OSS GIS tools for LPIS checking was positive. All the planned checking procedures could be implemented using OSS GIS. OSS tools were robust reliable and user friendly and presented a good performance.

Comparing LIDAR DTM with DEM-5 of Hungary

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Keywords: DEM, DTM, ALS, LIDAR, topographic map, inland excess water

Abstract

Requirements for precise digital elevation data (i.e., Digital Elevation Models, or DEMs) of varying levels of detail are being formulated for different fields of application, such as inland excess water research in the Maros- Körös Interfluve. In this study two different digital terrain models were compared: the DEM-5m of Hungary and DTM-1m (Digital Terrain Model) generated from Airborne Laser Scanned (ALS) data. ALS data as well as stereo aerial photographs were acquired on three different areas in November 2009. The ALS data set was used to create a 70 km² DTM-1m. The data set of DEM-5m used for comparison consisted of high resolution (5 m × 5 m pixel size, accuracy in Z 0.7 m) DEM derived from Hungarian topographic maps at scale 1:10 000 and points of IV. order triangulation network (accuracy in X, Y – 0.05 m, in Z – 0.1 m). Results are compared for both DEM generation techniques to the data received from in-situ measurements. Visual and statistical assessments were made, including profile and contour comparisons, allowing the spatial variation in accuracy to be explored. A mean vertical difference of 0.3 m and a standard deviation of c. 0.7 m were calculated. Maps of differences were created for all sites. The differences are both natural and antropogen forms. The negative forms are canals, old river channels and - at two places - soil hiatus caused by archeological excavation for which the orography is temporarily in evolution. The positive differences are the dikes of the dirt roads and accumulations by old river channels. These forms do not appear at DEM-5. And furthermore there are two errors on DEM-5 which cannot be explained with surface forms. The digital terrain model DTM-1 that has been created incorporates natural geomorphological forms that are essential for inland excess water modelling and can not be identified on the DEM-5 model of Hungary.

3D modelling of a lacustrine mouth bar complex

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Keywords: Törtel Formation, 3D modeling, lacustrine mouth bar system, reservoir characterization

Abstract

The topic of this presentation is the 3D modeling of a reservoir layer of Algyó Field's Törtel Formation. The depositional environment is mostly a lacustrine mouth bar system connected to a main channel and some smaller channels of the coastal marsh. The available log interpretations (porosity, permeability, Sw) mostly estimated inside the reservoir area. So the waterfilled sandstones and the coastal marsh parameters are non-representative. Therefore we defined two sandstone facies and two impermeable facies in 621 wells based on geophysical logs. This allowed us to use accurate indicator facies modeling based on the indicator variogram and the probability of the occurrence of the specified facies in a specified location. The modeling of spatial distribution of petrophysical parameters (porosity, permeability) is controlled by the 3D facies model and the directional semi variograms for each facies and sedimentation units. The clue is the mouth bar complex built up over many depositional cycles while sand deposition shifted to South-East direction as the underwater surface changed. The earlier built part of mouth bar complex was changed to a coastal marsh environment with smaller channels and bars. If a channel eroded the mouth bar sands to the earlier sand bodies then was filled with oil. Surrounding mouth bar sands were filled with water. The reservoir situated on the southeast area is mainly a channel - point bar complex. The meandering channels are diverging from one incoming main channel. There are no regional separation layers between depositional cycles of the great mouth bar complex but non significant changes of the lithological settings can biasing in changes of the in intrareservoir flow directions. According to these lithological changes individual mapping of these 4 sandstone units was necessary to analyse the inside trends of thickness and parameter changes. The 3 interbedded layers (representing transitions, impermeable intrabed clay, siltstone, and lig

The Statistical Analysis of Mineral Ore Production and its Transport to the City of Zagreb and the Zagreb County

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Keywords: greenhouse gas emission, spatial planning, lorry transport

Abstract

Mineral raw material transport directly affects a product's unit price and the amount of exhaust gases. The impact the lorry transport of mineral raw material has on the greenhouse gases emission will be discussed in detail. The transportation length is proportional to the raw material price and its low price enables short transportation distances only. What is becoming more and more important is the assessment of mineral deposits through the environmental impact of their exploitation, but it can rarely be expressed in monetary terms. Taking into account the consumption of stone aggregates, which are delivered from distant locations to the City of Zagreb, we tried to answer the question what the impact of transport distance on the greenhouse gas emission is. In the City of Zagreb and the Zagreb County, particularly within the protected areas of the Medvednica Nature Park, there is an obvious tendency to close existing exploitation fields. Our aim is to roughly present the additional emissions generated during the transport of the stone aggregates in relation to emissions in case the quarries are located nearby the city. By statistically comparing the environmental effects in both cases, it is going to be argued that the quarries' closures might not be best solution to the environmental pollution issue. Since the mining works are predestined by the site of mineral resources, and limited by real possibilities and intentions of the community, experts, i.e. miners, geologists and natural scientists, should be actively involved in spatial planning. (ŽIVKOVIĆ, S. A., et al.) The stone aggregates are delivered to the City of Zagreb mainly by the lorry transport from distances up to 100 km. During the years of intensive road and residential areas construction, up to 5 million tons of minerals were transported annually to the City of Zagreb. The question arises whether some more rational solutions could have been generated by a more appropriate spatial planning?

Connection between inland water development and motorways

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Abstract

Hydrometeorological conditions of previous autumn and winter periods, high groundwater, long periods of frozen soil are the main natural reasons of high excess water we had in the previous decade but presumably we can suppose many antropogen effects behind this phenomena. The most probable of them is the role of linear constructions e.g. railways, roads, embankments. Satellite images and aerial photos can prove the negative effects of these establishments on runoff of water. In the second part of the above mentioned period two motorways were built near Szeged: M5 motorway was opened between Kiskunfélegyháza and Szeged in December 2005 and M43 motorway to the north-western of Szeged was opened in 2010. In the spring of 2006 unprecedented high inland excess water was experienced in the surroundings of the village Szatymaz, next to both sides of the M5 motorway. Papers gave news about similar inland excess water appeared at the northern part of M43 motorway opened in the spring of 2010. The aim of our research is to find evidences to the swelling effect of the motorway in surface and soil water movement. In order to describe infiltration conditions several soil samples were collected along the motorway for laboratory examinations. Geodetic methods were applied to determine the surface and subsurface water level in more than 30 points. Plotting water relief let us know the main water movement directions. The results confirm and quantify our field observations that the M43 motorway operates as a dam and it does slow water runoff directing from NW to SE.

Application of geomathematics in description of turbiditic depositional environments, case study Kloštar Field, Sava Depression

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Keywords: geomathematics, Late Pannonian, Early Pontian, turbidites, Sava Depression, Croatia.

Abstract

Geological variables of reservoirs sandstone series were analyzed in the Kloštar Field, which is located W of Moslavačka gora Mt., but also SE from Kalnik Mt. Goal was possible observation of material source changing during Late Pannonian and Early Pontian. Accepted clastic source during both periods were Eastern Alps, and material had been several times re-deposited until reached the western part of the Sava Depression. However, palaeogeographic analysis open possibility that Moslavačka gora Mt. had some influence as a secondary source of clastics in Late Pannonian, which had been transported probably in short alluvial fans. That would be proof that the local palaeorelief had also role as sources of clastics around the Kloštar structure, but also in other places in the Sava Depression close to uplifted palaeorelief. Depth, thickness and porosity simulations were performed for the largest Late Pannonian and Early Pontian reservoirs. Lithology is similar, but the Late Pannonian sandstones are more compact, also characterised by more mica minerals. According to VRBANAC et al. (2010) there were two phases turbiditic activities. In the first, detritus was transported from NW, but later in the second direction of transport shifted from N, and locally even from N/NE. The main turbidite currents came from N/NW passed between Kalnik and Moslavačka gora Mts., almost directly toward Kloštar structure on the S. Simulations Gaussian maps showed such trend for Early Pontian in a direction of equal cell values.

Measurement of urban build up types based on segmentation of satellite imagery

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Keywords: remote sensing, segmentation, high resolution satellite image, urban land cover

Abstract

The spatial resolution of urban phenomena determines the amount of mixed pixels occurring in aerial and satellite imagery. In case of Szeged this a spatial resolution varies between 10 and 60 meter, meaning that the smallest entities in the urban land cover map can be found in this range. In an earlier long term monitoring study, the VIS model has been applied for the spectral unmixing of spectrally mixed pixels (Mucsi et al, 2009, Henits-Mucsi, 2010). In high spatial resolution satellite images the number of spectrally mixed pixels decreases and due to of this high geometric resolution and multispectral imagery, it is nowadays possible to apply object based image processing methods in urban land cover mapping. Apart from 3 visual bands, both 2004 IKONOS and 2011 RapidEye images with a spatial resolution of respectively 4 and. 5 meter, have a NIR band that allows for the analysis of man-made surfaces as well as vegetation surfaces. In this study, the satellite images have been atmospherically corrected using ATCOR 2 in Erdas Imagine 2011, while the segmentation has been executed in the Segmentation module of IDRISI Taiga and in Erdas Imagine 2011. In the segmented image, the geometric and spectral characteristics of the segments have been analyzed using statistical methods, the statistical parameters of the segments of the main urban land use types were studied, and a change map has been created based on a comparison of the segments maps derived from the two images.

Image analysis methods in examination of brittle microstructures

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Keywords: brittle deformation, cataclasite, fault breccias, image analysis

Abstract

Brittle deformation has a key importance in the fluid flow processes of the upper crust (cca 5-10 km), with its effect on permeability and storage capacity. In the crystalline basement of the Pannonian Basin, there are several fractured HC and geothermal reservoirs. Understanding of the brittle structures that now mainly represent cataclasite and breccia horizons is a crucial question on evaluation of these reservoirs. The aim of this study is to introduce the most widely used geometric parameters of the fault zones, and the methods of their measurement and application.

Some mechanisms of cataclastic processes are scale-independent, so the spatial extension of the microstructures from thin section to fault scale is possible, if applicable parameters were measured. These parameters are mainly geometric attributes, which allow the genetic classification and evaluation of the fault rocks. The methodological basis of the measurement is Petrographic Image Analysis (PIA) that is digitalised photos of the structures in question should be utilized.

Particle size distribution (PSD) carry numerous information about the circumstances of deformation, for example the degree of fragmentation and the displacement of the fractured clasts, as they usually follow power law distribution, and so have fractal character. Moreover, the different parts of a fault, the damage zone, the fault core and the slip zone typically have different PSD values. The degree of rotation, clast concentration and dilation are also important structural features of the brittle processes. It is also possible to distinguish diverse places within a fault zone that represent special petrophysical data using the above parameters. It also makes classification of single samples of unknown origin possible.

The complexity of the clast shape is a reliable indicator of the post-deformational chemical processes in every scale, as it also follows fractal geometry. In this way the intensity of fluid-rock interactions may also become measureable. Ratio of the clay and gouge content, the amount of cementation and dissolution as well as other descriptive attributes can further strengthen the results.

Using the above geometric data, several petrophysical and hydrodynamic properties of a brittle fault zone become interpretable. The main goal of the presentation is to introduce the possible image analysis methods and to illustrate their application through selected case-studies from fractured metamorphic HC reservoirs of the Pannonian Basin.

A Factor Model of the Relationship between Stream Sediment Geochemistry and Adjacent Drainage Basin Lithology, Medvednica Mt., Croatia

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Keywords: Stream sediment, Lithology, Drainage basins, Geochemical composition, Factor analysis, Medvednica Mt., Croatia

Abstract

A mathematical model is constructed to relate the geochemical composition of recent stream material in a number of catchments on Medvednica Mt. to a broadly defined bedrock lithology which represents the parent material for the former. It is a system based factor model, which synthesizes eight lithological and 25 geochemical variables (major, minor and trace elements), reducing their relationships to six geologically meaningful factors. Five of these divulged a definite relationship between geochemistry and lithology. These are labelled as follows: factor of metamorphic rocks; factor of igneous rocks; factor of Tertiary carbonate rocks; factor of parametamorphic rocks and factor of Mesozoic carbonate rocks. Two lithologies; the Mesozoic clastic rocks and Quaternary sediments showed no clear association to any of the factors. Alternatively, one of the factors (F2) can be identified as "non-lithologic" indicating other, perhaps anthropogenic, contributions to the stream sediment geochemical composition.

Estimation of the cavity effect by finite element modelling for the installation of extensometric measurement systems

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Keywords: extensometer, rock deformation, finite element modelling

Abstract

Geophysical extensometric measurements serve for examining tidal and further-originated rock deformations, monitoring recent geodynamical processes. Using the observations wide spectra of natural physical processes of the Earth (e.g. tidal phenomena, self-oscillation of the Earth, pole-motion, mass rearrangements, tectonics, climatic changes), furthermore man-made deformations (e.g. mining, industrial activity, water accumulation) can be analysed. As the instruments are usually established in natural or artificial caves, galleries, tunnels, wells under the surface in order to minimize environmental influences (changes in temperature, air pressure, humidity...), one has to take into account the distorting effect of the cavity system itself on the real rock deformations. The essence of the so-called cavity effect is that a rock matrix with a unique cavity system deforms differently than it would be filled with rock materials. This cause an inhomogeneity problem in the observation system. The calculation of the real cavity effect influencing the accuracy of the deformation measurements cannot be done analytically. In actual practice generally various installation rules are considered in the designing phase to decrease the effect. Finite element modelling has been performed to analyse the phenomenon in general. We calculated the deformations of 3D cavities with simple geometries caused by variable gravity loads. The cavity types used in the modelling have geometric parameters resembling the caharcteristic sizes and scales of arrangements in practice. Dependence of the cavity effect on changing of distinct geometric properties in categorized models has been investigated. Some calculations are carried out for more types of rocks having different elastic parameters. Modelling results provide an extended "parameter-effect" dataset. Obtained empirical functions could be used as an initial estimation not only for the absolute cavity effect rate of the intended arrangeme

Hydraulic characterization of the Szentes geothermal field using multiwell pulsing test – Preliminary results

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Abstract

In the Szentes region, - which is the most intensively produced Hungarian geothermal field - there are 3 Upper-Pannonian porous, thermal aquifers in 1600-2500 m deep and from these ones 40 wells extract water. The permeable sandstone and impermeable marl strata alternate frequently. This fact indicates that the aquifers are in connection and we would like to quantify the ratio of the horizontal and the vertical water flow mass.

In the last year 20 wells were relogged, single well tests as well as interference and pulsing tests were carried out at the Szentes area. During the multiwell test we generated 6 unequal pulses in the middle aquifer and in the same well group we measured the response amplitude in the upper and the lower aquifer as well as in farther to the middle aquifer perforated wells. A 6 day duration recovery interval followed this period and after that a 12 day long shut-in period with 3 production steps. In this paper we present the preliminary results of the pulsing test.

The time lag in vertical direction was 5-6 hours at about 250-350 m; at about 1800 m in horizontal direction was 2-3 hours. Calculating by Kamal & Brigham method the horizontal permeability is about 300-800 mD. The vertical permeability exceeds the horizontal. It is plausible to argue that this was caused by the insufficient annulus cementing. This problem was detected by single well logging.

On the basis of the interpretation of the interference and pulsing tests we shall be able to determine the hydraulic parameters with great accuracy, and to investigate there uncertainties. The gained data will be used to devise a regional hydrodynamical and heat transport model (MODFLOW, SEAWAT and FEFLOW codes). By these simulations the reinjection wells will be localized and the water management optimized.

Challenges of geomathematics: Turbidite modeling

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Keywords: Szolnok Formation, nonclassical turbidites, genetic similarities, object based modeling, intrabody structure

Abstract

Szolnok Sandstone Formation szPa1: Miocene deep water turbidites, composed of alternating, laminated, fine grained sandstone, aleurolite and clayey-marl, frequently collateral interrupted by strata-bounded carbonized plant relicts. The idea of handling the turbidite cycles as a single system with object based modeling algorithm raised after the reinterpretation of old geophysical logs and reservoir reassessment. Conducting the full-scale modeling procedure, our presentation describes this workflow in detail: 1. Identification on geophysical logs based on core analysis. Primary delineation based on seismic. Creation of body logs. 2. Design of turbidite body geometry. Creation of isochore maps, relative intensity map and the vectorfield. 3. Object based facies modeling, based on the Vertical Proportion Curve and above mentioned data. 4. Intrabody petrophysical modeling by using intrabody trends (vertical, along body, normal to body) 5. Studying the flow behaviour of the natural system's and of the model's as a feedback and control. Some local modification is necessary. The authors verify the workflow on Tiszántúl region examples.

Applied geostatistics – modeling of Szolnok Formation turbidite sequences

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Keywords: Szolnok Formation, Békés Basin, Turbidites, Object based modeling

Abstract

Modeling of pannonian sl. sediments is a very complex task because of the heterogeneity of the rock sequences. The inner facies and petrophysical structure of these reservoirs can only be described in highly detailed 3D models. The object based facies modeling is the most advanced method for modeling turbidite sequences, of which describes well the intrabody petrophysical structure. This study models the upper ~600 meters of the Szolnok Formation sequence of a pannonian age gas field located in the Békés Basin, where differences between sediment influx cycles determine the behavior of the individual reservoirs and their fluid composition as well. The model was divided to zones in addition to bigger sedimentation events, e.g. turbidite megacycles. We modeled each cycle separated but taking into account the continuity between them. Each cycle typically represent separate hydrodynamic units - reservoirs. 7 of the 13 reservoirs were identifiable on the 3D seismic cube. Seismic interpretation resulted in depth converted top maps, isochore maps and a series of seismic attributes for those 7 zones. The structural model was based on the seismic top and isochore maps, seismic interpreted fault model and sequential gaussi simulation of isochore maps based on well top information. In the object based facies model the shape and size distribution of the turbidite bodies were scaled both from literary data and from experiences of object based pilot models. The conceptual model of the local depositional environment and sediment influx directions (vectorfields) are mainly based on the high quality seismic interpretation. Progression of each cycle and regional changes in sand content are mainly influenced by the paleotopography defined by the previous sedimentary cycle. Spatial distribution of petrophysical parameters within the turbidite bodies are defined by intrabody grain size distribution trends of which are driven by the energy of depositional settings.

Application of Multivariate Analysis in Engineering Geology; Testing Sediment Properties in the Surroundings of a New Metro Station

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Keywords: engineering geology, metro, bentonitic clay, multivariate analysis

Abstract

The present paper describes the use of geomathematical methods in engineering geology of a construction site. Miocene aleurolites with various sand content and bentonitic clays are the most abundant sediments at the metro construction site at the study area (Rákóczi Square, Budapest). The drilling logs and documents, diaries of laboratory analyses were studied to better understand the local geology and to prepare a data base on engineering geological properties of the materials. Using this database, geological sections were prepared and multivariate analyses were used to have a better correlation of the rock beds in the area and the reconstruction of the geological evolution. These geomathematical methods have not been used before in this application in the engineering geology in Hungary. The samples were divided into five groups based on physical properties. These five parameters allowed the use of multivariate analyses as cluster-, and discriminant analysis. As a result it was possible to identify two types of bentonites with substantially different properties, one clay with high plasticity, one medium clay and one sandy, lean clay and mud group.

Explorative data analysis on the River Tisza (E Hungary)

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Keywords: Tisza, water quality, wavelet analysis, principal component analysis

Abstract

The River Tisza is one of Central Europe's most important rivers. The Danube's largest sidearm (tributary stream). In the last one and a half century numerous anthropogenic activities influenced its area. Despite this fact the watershed area of the River Tisza, in comparison to Europe's other large rivers- is still considered to have on of the most natural river valleys in Europe (Zsuga 2005). It is for this reason that it is of our common interest to protect its area. The main aim of the presentation is to present a good example of the application of explorative data analysis methods on water quality data; and to point out the processes evolving in the River Tisza using single, and multi variate methods on its chemical, biological and physical data. It has to be underlined, that in the recent past, to achieve these kind of aims time series and bivariate methods were implied. A dataset of approximately 550,000 data was received for the time interval 1974-2005 from the whole Hungarian Tisza section. This high amount of data necessitates the use of single-, and multi variate methods such as principal component analysis (PCA), wavelet spectrum analysis when it comes to the information extraction from the available data (Kovács et al. 2010, Hatvani et al 2011). In this study, the upper Tisza section's five sampling locations were analyzed. Using PCA those processes were revealed that are controlled by numerous latent processes. It must be stated that these processes vary in space and time as well. Summer and winter seasons were analyzed separately. Results show that different latent background processes play determining roles, in the two seasons. In summer the processes related to nitrogen, while during the winter the processes in close relation to inorganic compounds are more determining. Above all, spatial variety was observable in the factors along with the already discussed temporal ones. To determine the processes' annual periodicity, wavelet spectrum analysis was

Sub-regional similarity of vegetation changes as shown by the example of pollen diagrams constructed from peat cores of two raised bogs in Co. Galway, Ireland

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Keywords: Ireland, peat bog, vegetation change, pollen source area, similarity

Abstract

Caraun Beg Bog and Ballinphuill Bog are ombrotrophic raised bogs in east County Galway. There are several archaeological features in the vicinity, including a large Bronze Age earthen hill fort. Both bogs were cored to obtain undisturbed peat cores. Detailed pollen analysis has been carried out on both cores. The aim of the analysis was to reconstruct woodland, land use and vegetation changes of the last few millennia. Emphasis has been placed on addressing the role of climate and people on vegetation change.

As there is considerable similarity between the two pollen diagrams, it seems to be logical that the vegetation and the changes of vegetation in the pollen source areas were similar. Multidimensional non-Euclidean distance of the two datasets will be used to show the measure of similarity. The two-dimensional overlapping of the pollen source areas will be counted for probable radius lengths. The aim is to find out if the similarity of the diagrams comes from a highly similar pattern of sub-regional vegetation changes. Alternatively, a considerable overlap of the pollen source areas of the two bogs could cause such similarity. The findings are presented in poster format.

Some scale-related problems of crop modelling

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Abstract

Models are describing the complex reality with simplified mathematical formulae. With the help of crop models we can predict the volume and the quality of the expectable yield based on the input data. It is essential to determine the validity range of models due to the temporal and spatial scale related problems of measured input data.

We may get different results depending on the frequency of data collection at the experiment site and depending on the extent of heterogeneity of the pilot area. Scale related problems appear as uncertainty factors of input data as well as of model results.

Some significant temporal and spatial scale-related problems were investigated using the data of the Órbottyán experiment site having humic sandy soil. A meteorological station has been installed where measured data is recorded in every 5 minutes and soil temperature is recorded in every 15 minutes at 5 different depths.

The experiment site consists of four 10×15 m parcels. Along the diagonals, three access-tubes have been installed in every parcel. Soil moisture content was measured 0.1 m resolution using a TDR (Time Domain Reflectometry) probe. Complete soil physical measurements (pF, particle size distribution, etc.) were carried out on every layer of the soil profile when the access-tubes were installed. 4Mx and HYDRUS-1D simulation models were run using the available data. The simulation results were considerably different depending on whether input data measured in 5 minute intervals or daily means were used. The spatial scale dependency explicitly manifested through the heterogeneity of soil physical parameters of the four investigated parcels. Considerably different results were obtained when the parameters of the parcels were averaged prior to the simulations from those when independent simulations were carried out for each parcel and the results were averaged after the model runs.

Fracture network geometry in the depository area (SW Hungary, Bábaapáti)

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Abstract

It is of basic importance to get reliable information of fracture networks of the different geological formations, in order to understand fractured hydrocarbon reservoirs, to optimize radioactive waste depository or even to exploit geothermal energy.

The low- and intermediate-level radioactive waste depository is under construction in the Variscan Mórággy Granite Complex (MGC) in SW Hungary. This is an intensely fractured hard rock body, which is cut by numerous fractures. Because of safety reasons it is essential to know well the fracture network geometry and its long-range behaviour.

Although, there are numerous simulation methods for fracture network modelling, input data determination approaches are still full on subjective decisions. That is why the aim of the study was to put a standardized algorithm itself without subjective decisions together for determining the basic geometric parameters (length: E ; fractal dimension: D) of a fracture network. For calculations and testing the methods digital images of numerous headings of the repository site were utilized.

Digital images of fracture patterns of over 30 headings were processed using image analysis approaches to get the exponent (E) of the power-law ($N(L) = F \cdot L^{-E}$) fracture length distribution. Prior to calculating the E parameter by linear regression of the log-log transformed distribution function, several points of the histogram must be cancelled following well-defined rules. The fractal dimension (D) was calculated from the fracture midpoint distribution, using the "box-counting" algorithm. The measurement procedure for calculating fracture network parameters does not contain subjective decisions and the resulting geometric database can be used for fracture network simulation.

Finally, using the determined E , D , α , β (strike and dip) values a 3D fracture network model was computed using the REPSIM code. We used fracture orientation data sets (dip, strike – α , β) of previous structural geological studies.

In summary, the fracture network pattern is highly heterogeneous with two intensely deformed zones and a moderately fractured area in the middle of repository.

The reconstruction of past hydrologies of river tizza using multivariable archeomalacological analysis

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Keywords: multivariable paleoecological analysis, freshwater shellfish, , riparian environment

Paleoenvironmental studies are gaining increasing importance in understanding relations of man and environment for prehistoric communities world-wide. Several methods have been deployed to capture various aspects of the past environment hosting archeological cultures, most of which have long-lasting scientific background and are extensively used in daily research. In those areas where prehistoric sites are confined to rivers or lakes, a new promising tool in capturing the interaction of man and riparian environment might be that of the extensive analysis of freshwater mollusks retrieved from archeological sites. Since these mollusks collected by humans on the one hand characterize the quality of the water body from which they derive. Furthermore, they also yield us information about the use of second-line aquatic resources in subsistence. Faunal changes observable in the shellfish material must be attributed to various factors, if we appreciate the human or cultural context of the material. Thus to resolve issues of temporal change observable in the studied archeofauna a complex analysis of several lines of information is needed. To achieve this goal a new multi-proxy paleoecological analytical method was developed based on the collective handling of faunal taxonomic and demographic data as well as the geochemistry of the shells along with information on taphonomic bias and role of shellfish in both subsistence and other type social, behavioral activities. As a first step the main physical and chemical properties of fluvial and floodplain aquatic habitats (substrate conditions, hydraulic parameters, water temperature, pH, bioproduction, sediment accumulation) surrounding the site is reconstructed based on the analysis of faunal abundance, ecological and geochemical data. A regional reconstruction of the riparian environment highlighting potential differences and short-term sub-centennial transformations as well as background causes follows. The received pattern is then interpreted in the light of cultural, economic and human behavioral patterns gleaned partly from the archeology of the sites and proxies gained via the analysis of taxonomic and demographic composition of the studied faunas reflecting foraging strategies. Finally, potential alterations inferred for the local natural shellfish population as a result of foraging strategies employed is also assessed. The presentation will highlight the most important aspects of the method touching upon the mat-stat components used to derive proxies for describing the physico-chemical properties of the studied freshwater system of the River Tisza with examples for the Hungarian Neolithic.

Analysis of geothermal wells according to the geophysical research in the south-eastern area of Hungary

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Keywords: geophysics, geothermal energy, well logging, geostatistics, SPSS.

Abstract

The geothermal field near Szentes, is known from the 1950's, as a result of abortive CH-exploration. The drastic decrease of the hydraulic head and the wastewater disposal into the surface water causes serious environmental problems. Within the project the wells and their mutual effects on the geological surroundings are being examined completely. The project investigates where and under what exploitation and technological circumstances it is justified to reinject thermal water so that the exploited water can be refilled and the exploitation can be planned and maintainable on a long term. The article presents the circumstances of the examinations and the results based on the geophysical and hydrodynamics well loggings of all the 20 geothermal wells in the area. As a part of the main project we focus on evaluating how geological environment as well as technological details of water production may determine behaviour of the wells.

In addition to stratigraphic data, the complete database of the research includes casing diameter, gamma ray log, well bottom checking, temperature loggings among several others. During the basic hydrodynamic tests flow rate and place of active perforations were determined. Using these data it can be calculated what proportion the perforations contributes to the yield of the certain well. Advanced pumping test includes surface and depth depression measurement as well as determination of pressure and water level increasing during recovery pressure gradient measurement.

Utilizing the above measurements one can calculate the flow rate, the well productivity factor on the surface, and in depth, depression and the factor describing the nature of flow on the surface and in depth, respectively. The effective permeability in the close surrounding of the well can be computed from depth pressure measurement using the Thiem equation assuming steady-state condition.

Using the whole above dataset diverse multivariate methods were applied in order to test whether or not groups of wells exhibit different hydrodynamic behavior depending on the geological, hydrogeological framework and technical details of production. Our results suggest that the wells can clearly be classified.

Sedimentological modelling of ap-13 hydrocarbon reservoir

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Abstract

In Hungary the most characteristic aspect of hydrocarbon exploration is the Algyő field, because this is the largest oil and gas occurrence of this country. About 1960 the seismic and magnetic gravimetric maps showed the crest of the Algyő structure. It was supposed that in the thick basin deposits the conditions were favorable for the hydrocarbon development, migration and trapping. The research turned to the relatively lower position blocks which meant to cope with the increasing pressure and temperature. This study is focused on Ap-13 gas cap reservoir, which is situated between 2400-2550 m (TD) its thickness is from 4 m up to 50 m. This reservoir is from the lower Pannonian which is part of the Szőreg formation.

The oil industry has the strength to influence the researching projects. There are many former and recent studies about the delta system of Algyő. Among these studies I found papers about Ap-13, where this reservoir is divided into 5 sections (Hniszné 1996). The paper aims to reconsider the construction of this reservoir under a new approach.

During the examinations I made macro-scale sedimentological model by Markov-analysis, maps with Golden Software Surfer, I defined the vertical sedimentological facies of A-993 borehole with Golden Software Strater, analyzed a mega-scale sedimentological 3D model with Golden Software RockWorks by using up the petrophysical features of 141 boreholes.

After these procedures, I could arrange the sand content in the adequate depths to the vertical profile of A-993 borehole. Assume the results of the imbedded Markov model and the 3D sedimentological model, it is a deep-water sand-body, which has a sand content less than 55% and aleurolite content around 30%. It can be characterized by the features of proximal middle fan systems.

The mechanics of rocking stones

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Abstract

Rocking stones (i.e. large stones that are balanced in counter-intuitive positions) have not only interested geologists but also were associated with a wide variety of beliefs e.g. they were connected to witchcraft. These large stones are so sensitively balanced that they can be used to estimate the maximum level of ground motion (earthquake) that could have occurred since the rocks have been in their current situations.

Our goal is to give a simple mechanical explanation for the existence of rocking stones. We show that on many-faceted polyhedral surfaces e.g. on the convex hulls of rocks and pebbles, equilibria typically occur on two scales: the micro and macro scales. Since rocks are balanced on their convex hulls, this observation appears to be relevant. If we take a close look at rock morphology, we can observe many micro-equilibria, which are located in distinct groups on the surface and an outside observer identifies these groups as 'macro-equilibria'. Both micro and macro-equilibria can be either stable or unstable, however, a rock can only be physically balanced on a stable micro-equilibrium. If the latter belongs to an unstable macro-equilibrium, outside observer perceives that the rock is balanced in a counter-intuitive position, since the stability properties of micro and macro-equilibria differ. We show that the last described situation is characteristic for real rocks and pebbles i.e. it can explain the phenomenon of rocking stones.

Indicator vs. Gaussian geostatistical methods in sandstone reservoirs - Case study from the Sava Depression, Croatia

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Keywords: Simulations, deterministical methods, sandstone reservoirs, Kloštar field, Sava depression

Abstract

Geostatistical methods are very often used in reservoir modelling, but sometimes the hardest question is which method should be used to obtain the most realistic solution. Many geologists prefer determinism despite the fact that there is just one solution obtained. Simulations in contrary provide as many realizations as we want, so with 5-10 realizations we can get a quick inside in the uncertainties of mapped area, but with 100 realizations 95% of all possible uncertainties is covered and the areas with the highest uncertainty can be outlined. Lower Pontian sandstone reservoirs of the Kloštar Field (the Sava Depression) are mapped by deterministic and stochastic methods. Input variables were porosity, thickness and depth. Applied deterministic methods were Ordinary Kriging (OK) and Indicator Kriging (IK) and stochastic were Sequential Gaussian Simulations (SGS) and Sequential indicator simulations (SIS). Results showed that in some cases stochastic methods gave the better solutions, and in some others deterministic was more appropriate. Results also showed that the most important question is not which approach to use, rather what we want to get with mapped variables? If we want to get some knowledge about depositional environments and lithofacies changes by porosity mapping, best results were obtained by IK and SIS. On the other hand SGS showed better solutions if the maps should show the structure but also in property distribution inside the reservoir.

Inland excess water mapping using a combined Artificial Neural Network - Geographic Information System approach

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Keywords: Inland excess water Artificial neural networks Risk mapping Remote sensing GIS

Abstract

Inland excess water is a phenomenon where surplus water accumulates in local depressions on flat terrain without sufficient runoff and infiltration capability of the soil. In Hungary, on the great Hungarian plain these inundations are a common problem. The year 2010 was one of the wettest years in a century, causing exceptionally large areas to be flooded by inland excess water. The maximum total area that was flooded was 355.000 ha and the estimated financial damage to the agriculture was exceeding 500 million Euro. To be able to prepare and possibly mitigate the effects of inland excess water, it is necessary to create vulnerability maps showing the risk of inundations on a large scale. These maps have been created in Hungary since several decades. Traditionally these maps are created by combining and weighing multiple factors that influence the formation of inland excess water, like precipitation, relief, soil, ground water, land use, geology and hydrology. The weighing factors are empirically derived based on known locations of inland excess water (Pálfai 2003, Pásztor et al 2006). The weights are limited to a certain area and time. Changes in time or location require redefinition of the weighing factors. A second method that is used to study the occurrences of inland excess water uses remote sensing imagery. Satellite images or aerial photographs are classified and used to identify locations of actual inundations (Rakonczai et al 2003). In this research, we demonstrate a new method that combines an artificial neural network (ANN) and GIS techniques to derive vulnerability maps using inland excess water factors as well as remote sensing images. The ANN – GIS framework combines natural and anthropogenic factors with high resolution satellite images and near infra red aerial photographs to train a neural network. The adaptation of the weights of the different factors involved in the formation of the inundations is an integral part of the training phase of the ANN

Modelling and verification

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Keywords: model, verification, validation

Abstract

The final disposal of radioactive waste in a repository facility may be licensed if there is proved: during operation, modification, termination, or closure of the facility the radiation exposure of the employees and the population will not exceed the dose limits determined by the National Medical Officer Board in the course of the establishment licensing procedure.

Lifetime of the waste disposal system extends from 100 000 years to 1 000 000 years depending on the period following which activity concentration or the activity of the stored waste decreases to a level that corresponds to clearance (exemption). Thence it follows that the analysis of impacts and risks for final disposal facility, considering both the designed normal operating conditions and the not designed (accidental) situations need to be carried out for that length of time.

The safety assessment of the final disposal facility is founded upon 3D/4D modellings. First geometrical, geological, geophysical, rockmechanical, thermal, hydrogeological, chemical, transport and biosphere models of final disposal facility are done. The site descriptive model is a multidisciplinary interpretation of geology, rock mechanics, thermal properties, hydrogeology, hydrogeochemistry, transport properties and ecosystems using site investigation data as input. The site descriptive model forms the base of radiation exposure calculation of the population and on the basis of site descriptive model are done the logical, mathematical and computational model of final disposal facility.

There is an essential requirement to demonstrate the reliability of each component of modelling process. If somebody can discredit some steps of modelling process, that discredits the result of radiation exposure calculations in no time.

In the course of analysis of reliability of modelling should be tested:

- whether model has all the necessary components, namely to consider that the model is built correctly. This process is known as model verification.
- whether the model represents reality, namely to consider that the correct model has been built. This process is known as model validation.

Whereas verification is the continuous process of insuring that the model is built correctly, validation is the process of insuring that the model represents reality.

A model should be not attempted to validate if the same model has been not successfully undergone the verification process.

The presentation presents some issue of model verification and validation in the radioactive waste management practice and dwell on question, whether hidrogeological models can be validated or can't.

The effect of Coriolis-force on the river course

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Keywords: Coriolis force, river flow evolution, remote sensing

Abstract

It is common knowledge that the moving objects change their trajectory in a rotating system due to the inertia thereof and therein. This phenomenon had been named after the French mathematician, Coriolis, who had described this force in the year 1835. In 1851 Foucault used this phenomenon in order to prove the rotation of the Earth by a pendulum hung up in the Pantheon in Paris. His genial idea conceived that during that movement, the oscillation plane of the pendulum will change and this event can be attributed to the rotation of the Earth. The second successful attempt for this experiment was performed in Hungary, in the year 1880 in Savaria – Szombathely by Adolf KUNCZ and his disciples (the Gothar brothers) by a pendulum hung up in the dome of the Roman-Catholic cathedral. It has been commonly approved albeit that the rotation of the Earth has relevant impact upon geological processes as well. This phenomenon can be traced by watching the course of the river flows. For instance in Hungary one can witness either in field inspections or by interpreting the remote sensing images that our two major rivers flowing from North to South, the Tisza and the Danube, project west-bound channel migration.

Colour Analysis of the Boda Claystone Formation in Borehole Ib-4

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Keywords: Colour Analysis; Boda Claystone Formation; Cycle Stratigraphy; Mecsek; GIS

Abstract

We have developed a digital colour analysis method to examine the Boda Claystone Formation. The Permian Boda Claystone Formation (BCF) occurs in the Mecsek Mountains and a country-wide screening found this formation is most capable for the disposal of high-level radioactive waste in Hungary. "The most monotonous formation in the country" (JÁMBOR 1964) is composed of sandstone, (albitic) silty claystone, (albitic) clayey siltstone and dolomite. The colours of these types are reddish-brown or brownish-red (or any colours between brown and red); the sandstone interbeds have similar tones but usually lighter and the dolomite is white. Because their colour similarity, not all rock types can be consequently identified by the naked eye.

Our GIS method could be utilized to distinguish similar colours and to identify the soft transitions between these colours. It is important, because these colour changes and transitions through the formation have a cycle stratigraphical meaning. Geophysical well logs proved the existence of the characteristic cyclic units detected by natural gamma and resistance values.

We have found that our method is capable to get the same cycles as the geophysical methods and also it provides some new results. We hope this idea can be useful as a digital extension of the geologists' eyes and the traditional geophysical examinations.