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Abstract Book

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Using MVS software for modeling of the measurements carried out in Bátaapáti site

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Keywords: C Tech, MVS, geostatistical analysis, three-dimensional visualization, Bataapati site

C Tech's MVS software unites the advanced gridding, geostatistical analysis, and fully three-dimensional visualization tools into a software system to address the needs of all Earth science disciplines. The software can be used to analyze all types of environment, geological, geotechnical, geophysical, and hydrogeological data. In the first part of the presentation the integrated geostatistical potentials will be shown on a practical example. The second part will give a short look-in the visualization ability of the software using geological, geophysical results from the Bataapati site.

Trace elements distribution of saline lakes' sediments

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***Keywords**: Trace element, sediment, statistical analysis, saline lake, Fehér-Lake.*

The present study was aimed to shed light onto the parameters and processes, which trigger and control the adsorption, mobilization, distribution and enrichment of trace elements and natural radioactive elements occurring in the solid phase of alkaline lacustrine deposits. The recorded element concentrations, distributions, mineral composition, as well as the organic matter content measured in the studied deposits are also given.

The studied lacustrine system of the Fehér Lake near the city of Szeged in SE Hungary is part of the Kiskunság National Park, with an area of 14 km^2 and a watershed of about 200 km^2. The lake itself is now utilized as a fishery. It is important to highlight from the point of possible contamination sources that the public refuse disposal site of the city of Szeged is hardly 1 km away from the lake, similarly to the Tisza river, which ensures continuous water supply into the lacustrine basin via artificial channels when needed.

One major goal was to determine the concentrations of natural radioactive elements in the samples (^{238}U, ^{232}Th, ^{40}K), plus those of 12 vital trace and 5 major elements. In order to accurately interpret the recorded values and the elemental distributions, the mineral composition and TOC of the samples were also analyzed.

The gained results were subjected to further statistical analysis. A correlation of the recorded main, trace and radioactive elements with the mineral composition and TOC was determined. Plus a distribution map of the studied elements was prepared to determine the possible relationships between the studied sediment components.

The recorded amounts of natural radioactive isotopes in the lacustrine deposits, although 5-10 times higher than the average, are no harm for fishes bred in the lake.

Among the studied trace elements, the amounts of As (20 ppm), Cr (70 ppm), Cu (42 ppm), Mn (596 ppm), and Ni (34 ppm) are close to the contamination limit values mentioned in the MI-08-1735-1990 decree. In certain sample sites these values are even higher than the limit values. Generally speaking the amount of trace elements are those of the crust average.

Based on our initial findings, further studies are required to determine the chemical parameters and processes influencing the adsorption and mobilization of trace elements.

GRAPHCLUS, A MATLAB program for cluster analysis using graph theory

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***Keywords**: Cluster analysis, Graph theory, Classification.*

Cluster analysis is used in numerous scientific disciplines. A method of cluster analysis based on graph theory is discussed and a MATLAB code for its implementation is presented. The algorithm is based on the number of variables that are similar between samples. By changing the similarity criterion in a stepwise fashion, a hierarchical group structure develops, and can be displayed by a dendrogram. Three indexes describe the homogeneity of a given variable in a group, the heterogeneity of that variable between two groups, and the usefulness of that variable in distinguishing two groups. The algorithm is applied to a synthetic dataset and compared to other available cluster analysis algorithms. Following clustering by various methods, the results were evaluated using the consistency index. The consistency index can be computed for an inner point I of an arbitrary dendrogram as $C_i^l \frac{A_i^{obs}}{A_i^{total}} \prod_{i \neq j} \left(1 - \frac{A_j^{obs}}{A_j^{total}}\right)$, where *i* and *j* vary between one and the number of groups. The results suggest that using the GraphClus algorithm an accurate clustering can be achieved, as well as the new approach outperformed the other often used cluster algorithms (complete linkage, single linkage, average linkage).

3D estimation of the vitrinite reflectance values of Pannonian sediments in the Jászság Basin and environments – a new approach

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Keywords: vitrinite reflectance, 3D estimation, Jászság Basin

The reflectance of vitrinite particles measured under oil immersion (vitrinite reflectance – R_o) is one of the most important parameters characterizing the maturity of organic matter and – consequently – hydrocarbon exploration. In most cases, R_o needs to be estimated in 3D by using experimental formulas. However, some formulas are published (Koncz, Hámor-Vidó and Viczián) earlier, the reliability of them are questionable in the level of data, because the difference between the measured and calculated R_o values is significant.
Regarding the temperature, time and pressure dependence of R_o values, more accurate formula could be defined. The area's map of inverse geothermic gradient (gl) can be drawn based on the available data of temperature and depth acceptable in industrial practices. Also, the sedimentation period of each layer can be calculated considering the "almost regular" sedimentation of the deeper areas of the Pannon-basin and the estimated time frames of the ages.
On the basis of previous observations and correlations between measured R_o and time (t), depth (z), inverse geothermical gradient (gl) and temperature (T), the following equations could be calculated concerning the sediments from the Jászság basin of the Pannonian age:

$$R_{o-sz} = 0.0387 \cdot e^{0.1572 \cdot \lg(t) \cdot gl} \qquad \text{if } R_o < 0.7\ \% \text{ and}$$

$$R_{o-sz} = 10^{1.469 \cdot 10^{-9} \cdot z^2 \cdot T^{0.5} - 0.1862} \qquad \text{if } R_o > 0.7\ \%$$

Although these equations will need to be corrected and might be generalized at a later stage, and the uncertainty of the data gained this way might also be significant, the values of R_o measured in the organic matter samples from the area can be estimated significantly more accurate (R^2 = 0.961 between measured and calculated R_o) than according to the linear relations between Ro and the depth, which had been assumed earlier.

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HÁMOR-VIDÓ, M., VICZIÁN, I.: Vitrinite reflectance and smectite content of mixed layer illite/smectites in Neogene sequences of the Pannonian Basin, Hungary, Acta Geologica Hungarica, 1993, Vol. 36/2, pp. 197-209
KONCZ, I.: Overview and interpretation of organic geochemical data of Jászság Basin, manuscript, MOL Plc., 1989

A földtani paraméterek hatásterületének közvetett számítása

Füst Antal

Keywords.

A tanulmány a paraméterek hatásterületének új, az iránymenti szórásnégyzetek felhasználásával történő számítási módszerét mutatja be. Ehhez bevezeti az iránymenti szórásnégyzet fogyalmát. A javasolt módszer olyan esetekben is lehetővé teszi a hatásterület számítását, amikor az iránymenti félvariogramok bizonytalansága miatt a közvetlen számítás nem lehetséges. Az alkalmazás feltétele, hogy a parameter változásában mind a geometriai mind a zonális anizotrópia érvényesüljön.

Mapping the urban surface roughness in an entire urban area for urban climate applications

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Keywords: urban roughness mapping, frontal area, roughness length, porosity, Szeged, Hungary

The overall purpose of this study is the presentation of an urban roughness mapping method in a large study area in Szeged. The specific objectives are (i) to describe the application of the roughness length calculation method in irregular building groups, (ii) to present the calculation of porosity in the urban canopy level, and (iii) to find the potential ventilation paths in the study area using the calculated urban roughness parameters.

With this roughness mapping procedure we can locate the ventilation paths in the city. The supposed ventilation paths could take a significant role in the development of the urban heat island circulation and as a result in the reduction of the air pollution in the inner part of the city. These results could provide important input data for the urban planning procedures. Based on our results we can give a list of the areas where the city government should have to keep the advantages of the ventilation paths considering the human comfort aspects of the urban climate.

For describing the roughness of the surfaces numerous parameters are known. The prevalent parameters are the zero-plane displacement height (z_d) and the roughness length (z_0). Also known parameters are the roughness element density (λ_p), frontal area density (λ_f), average heights weighted with frontal area (z_H), depth of the roughness sublayer (z_r) and the effective height (h_{eff}). The porosity of the urban canopy layer (P_{UCL}) can be also useful tool for urban roughness mapping.

The calculations of the roughness parameters (z_d, z_0, λ_p, λ_f, P_{UCL}) based on 3D building database and they are more detailed than other recent studies. Our calculation based on the plot area polygons is a new approach and there are no similar examples in the literature according to our knowledge.

The results of the statistical evaluation of the Late Neolithic shellfish fauna of Szegvár-Tűzköves

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Keywords: archeomalacology, statistical evaluation, Late Neolithic, shellfishing, mean-size reduction, overexploitation, Wilcoxon test, Kruskal-Wallis test

The Late Neolithic in the Southern Great Hungarian Plains is represented by members of the Tisza Culture. This cultural group populated the elevated Pleistocene lag surfaces of the floodplain of the major and minor rivers, corresponding to the former natural levees of Pleistocene riverbeds creating multilevel tell settlements populated for several hundred years and covering and area of several hectars. Although agricultural production was the gist of subsidence of these groups, they were also engaged in various forms of foraging to complement their everyday needs as shown by the numerous empty shells, fishbones and bones of wild animals retrieved from the settlement horizons and waste ditches of these tell settlements.

During the archeological excavations of the Late Neolithic tell site of Szegvár-Tűzköves ca. 2700 shells were retrieved from 28 micro horizons. Representatives of 4 shellfish taxa was identified in the material: *Unio pictorum* (Linné 1758), *Unio tumidus* Retzius 1788, *Unio crassus* Retzius 1788 and *Anodonta cygnea* (Linné 1758). The detailed morphometrical, paleoecological and statistical analyses of the shells revealed information on why, where and how the shellfish was harvested and utilized by the Late Neolithic population of the tell. Out of the 2680 shells 1653 was suitable for taking measurements and used in a detailed statistical analysis. In case of the measurable valves the valve height was recorded using a caliper with and accuracy of 0.01, and the gained value was used to predict the meat yield of the shells. This also highlights the approx. number of people who might have gained food from the meat. When the recorded parameter is studied along a vertical profile along with the number of harvested shells, we can get a good picture of the strategy devised by the former human foragers, the underlying reasons of the chosen strategy, plus whether or not the chosen strategy resulted in any size and/or compositional changes in the natural shellfish population.

As shown by the gained results, shellfishing was continuous throughout the life of the tell with varying intensities. There is no change in the environment of the harvest; i.e. the floodplain as it is shown by the univocal dominance of the taxon *Unio pictorum*, preferring stagnant waters along the profile. The most intensive period or peak harvest can be identified at level 22. The number of harvested shells is negligible below and above this horizon. Stratigraphically speaking, this collection peak must correspond to the phase of initial settlement when alternative food sources were relatively restricted. During the life of the tell dominantly a single taxon was targeted with collection of the larger, older forms yielding more meat as expected (*Unio pictorum*). In the level of peak harvest the mean size of the harvested population of *Unio pictorum* is significantly larger than that of the whole material (Wilcoxon test $p < 0.0001484$). This highly selective foraging strategy, both regarding taxa and size classes caused significant changes in the size composition of the targeted natural shellfish population. The relatively wide size ranges and the large number of outliers in the lower part of the profile indicate maximized foraging efficiency. There seems to be a statistically significant upward reduction in the mean size following the collection peak of horizon 22 (Kruskal-Wallis test $p < 0.05$). With a reduction in the intensity of shellfishing the mean size of the population is also stabilized (Kruskal-Wallis $p=0.942$) displaying even a minor increase from horizon 14 upwards. This is a clear sign of human-induced size reduction in the natural population technically termed as overexplotation. This feature was formerly observed by the first author in several other Hungarian Neolithic profiles as well.

Szegvár-Tűzköves késő neolit tell lelőhely kagylóanyagának statisztikai értékelése

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Kulcsszavak: archeomalakológia, kagylógyűjtés, statisztikai értékelés, késő neolit, átlagméret csökkenés, emberi túlgyűjtés, Wilcoxon próba, Kruskal-Wallis próba

A Dél-Alföld neolitikumát Kr.e 4900 és 4400 között a Tiszai Kultúra népei képviselték. Ezek a népek az egykori folyóvízi árterek kimagasló maradványfelszínein, melyek az egykori pleisztocén folyók természetes partgátjainak tekinthetők több hektárnyi kiterjedésű, évszázadokig lakott településközpontokat, újkőkori telleket hoztak létre. A tellek népe bár alapvetően növénytermesztésre és állattenyésztésre alapozta megélhetését, részben halászó-vadászó és gyűjtögető tevékenységgel is kiegészítették mindennapi táplálékukat. Erről tanúskodnak az ásatások során előkerülő nagymennyiségű kagylóhéjak, halcsont maradványok és egyéb vadállatok csontjai is.
A Szegvár-Tűzköves késő neolit lelőhely régészeti feltárására során 28 mikroszintből mintegy 2700 db kagylóhéj került elő. A 2680 db teknőszámból 1653 volt mérhető és alkalmas statisztikai értékelésre. Négy édesvízi kagylófaj fordult elő a megtalált neolit anyagban: *Unio pictorum* (Linné 1758), *Unio tumidus* Retzius 1788, *Unio crassus* Retzius 1788 és *Anodonta cygnea* (Linné 1758). A héjak részletes biometriai és paleoökológiai viszgálata révén fényt tudtunk deríteni arra, hogy az egykori késő neolit tell közössége milyen környezetből, hogyan gyűjtötte a kagylókat és ezeket hogyan hasznosította. A kagylóhéjak taxonómiai meghatározását követően elvégeztük a héjak magasságának mérését a mérhető teknők esetében majd a kapott változók segítségével becsültük meg a héjak hústartalmát és azt, hogy mennyi táplálékot adhattak az egykori közösségeknek. A gyűjtött kagylók mennyiségének, valamint méretparamétereinek függőleges szelvény mentén történő időbeli elemzésével információt nyerhetünk arra vonatkozóan, hogy milyen gyűjtési stratégiát alkalmazott az egykori közösség, milyen célból alkalmazta az adott stratégiát és ez a választott stratégia okozott-e változást a természetes kagylópopulációban?
Eredményeink szerint a kagylók gyűjtése a tell közösség élete alatt nem volt egyenletes. Az ártéri gyűjtési környezet nem változott, amint azt az álló vizeket kedvelő *Unio pictorum* egész szelvény hosszában megmaradó dominanciája is mutatja. A gyűjtésben egy intenzívebb periódus figyelhető meg a szelvény alján a 22. szint környékén. Előtte és utána bár folyamatos a gyűjtés, az egyedek száma elhanyagolható (zömmel 30 db alatt). A gyűjtési csúcs rétegtanilag valószínűleg megfelel a megtelepedési fázisnak, amikor

alternatív élelemforrások csak korlátozottan állhattak a közösség rendelkezésére. A tell teljes életében a gyűjtés zömmel egy fajra koncentrálódott (*Unio pictorum*). Ezen a fajon belül zömmel a nagyobb, több húst adó egyedeket gyűjtötték. Különösen igaz ez a legintenzívebb gyűjtési periódusra (22.szint), ahol a begyűjtött héjak átlagmérete szignifikánsan nagyobb az egész vizsgált anyagban megfigyelhető átlagméretnél (Wilcoxon próba p< 0,0001484).Ez a fajra és méretre is szelektáló gyűjtési stratégia jelentős változást okozott a dominánsan gyűjtött faj (*Unio pictorum*) populációjának méretösszetételében. A szelvény aljában a begyűjtött mérettartomány elég széles, ami maximalizált gyűjtési hatékonyságra utal. Ezt jelzi a kis és nagy mérettartományokban megjelenő néhány kiugró érték is. A gyűjtési csúcsot követően bár a begyűjtött mérettartomány valamelyest csökkent, még elég széles maradt, hogy jelentős csökkenést eredményezzen az átlagméretben. (Kruskal-Wallis próba p< 0,05). A gyűjtés intenzitásának normalizálódásával azonban a gyűjtött populáció átlagmérete is normalizálódik (Kruskal-Wallis p=0,942), sőt a 14 szinttől enyhe növekedésbe megy át. Ez egyértelmű jele az emberi túlgyűjtés okozta méretcsökkenésnek majd a populáció regenerálódásának. Ilyen módon jelen szelvényben is kimutatható az emberi hatás, amint azt már számos egyéb neolit kori szelvényben megfigyeltük (Nagykörü, Gorzsa).

A MAGYARORSZÁGI PANNÓNIAI KORÚ VIVIPARUS FAUNA BIOMETRIAI VIZSGÁLATA DUNÁNTÚLI FELSZÍNI FELTÁRÁSOK EGYÜTTESEINEK PÉLDÁJÁN

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Keywords.

A hazai pannonkori rétegekben előforduló *Viviparus* fajok sok lelőhelyen, jelentős példányszámban, és nagy formagazdagságban fordulnak elő. Ennek a formagazdagságnak a paleobiológiai értelmezése azonban problematikus. Felmerül a kérdés, hogy valóban különálló fajokról van-e szó, vagy csak néhány, esetleg egyetlen változékony fajjal állunk szemben. Kérdés az is, hogy a formagazdagságnak milyen okai lehettek.

A problémára biometriai módszerek segítségével próbáltunk választ keresni új szemléletű módszerek - korábban nem alkalmazott morfológiai paraméterek és a héj függvénygörbeként való értelmezése - segítségével.

A módszer lényege, hogy a korábban szubjektíven kezelt tulajdonságok - pl. a ház nyúltsága, kanyarulatok lépcsőzetessége - számszerűsíthető, és ezáltal objektíven értelmezhetők.

A pannóniai *Viviparus*ok esetében a vállasság foka az egyik olyan tulajdonság, amely ha számszerűen is kifejezhető, akkor a különböző formák ennek segítségével könnyebben elkülöníthetők. Sok esetben elegendő az egyes formák megkülönbözetésére a létrehozott négy vállassági kategória szerinti elkülönítés. A vállasság mértéke tükrözi legmarkánsabban az egyes alakok közötti átmeneti folyamatokat, illetve ezek térbeli vetületét. fontos szempont emellett, a definiált tengelymagasság szerinti nyúltsági arányszám, illetve a pontosabb határozás érdekében sokszor nem elhanyagolhatók a kanyarulatok egymáshoz viszonyított méreteiből képzett arányszámok sem.

Az eredmények alapján a formagazdagság ellenére nincsenek morfológiailag élesen elkülönülő csoportok. Ez megerősíti azt az elképzelést, amit már Bartha F. 1971-es munkája is körvonalaz, miszerint egyetlen faj, a *V. sadleri* Partsch létezett. Ennek azonban négy fő alakköre különíthető el és ezeket az eddig „átmeneti alakoknak” tartott formacsoportok alkotják:

1) *V. sadleri – V. cyrtomaphorus*,

2) *V. cyrtomaphorus – V. kurdensis*,
3) *V. kurdensis – V. gracilis* alakkör.
4) A negyedik a *V. balatonicus* irányába mutató alakkör, amelyet a további lelőhelyek feldolgozása hiányában, csak mint lehetséges, statisztikailag még nem alátámasztott alakkört tüntetem fel.

A különböző formák kialakulásának oka - amennyiben valóban nem genetikailag rögzített jellegekről van szó - a környezeti hatásokra adott egyéni válasz lehet (ökofenotípus). Ilyen környezeti hatásként vehető számításba a víz áramlása. A kúpszerű, nyújtottabb forma a folyó, áramló vízben való életet (kicsi ellenállás) segíthette, míg a zömökebb, vállasabb formák az állandó tavi környezetre utalhatnak. Ennek a hipotézisnek az ellenőrzéséhez szigorúan rétegenként gyűjtött minták elemzésére és paleoökológiai vizsgálatokra lesz szükség..

X-ray computer tomography in clastic sedimentology

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***Keywords**: clastic sediments, X-ray attenuation, numeric analysis, texture, grain size, autocorrelogram, spatial continuity, small-scale static flow.*

Depositional environments composed of diverse sedimentary facies that represent the variability of different physical, chemical and biologic conditions that generate characteristic textures and fabrics of clastic sedimentary rocks. X-ray attenuation of clastic sedimentary rocks generally depends on bulk density, effective atomic number, fluid content, and chemical composition of grains, cement, and fluid content if present. Grain size is one of the most important characteristics of texture that affect bulk density and X-ray attenuation, consequently. The resolution of medical CT is suitable to detect changes in X-ray attenuation originated in grain size alteration above 0,1 mm. Numerical identification of clastic sedimentary rocks based on the observation that every type of texture could be represented by different intervals of Hounsfield Units (HUs), taking age and depositional history into consideration, yet some overlaps might occur. To avoid overlapping expected value should be used if distribution of data set is normal, otherwise median or mean estimated by 'Maximum-likelihood' method recommended. Autocorrelation or rather planar correlogram is suitable for analyzing planar continuity in three-dimensions. The functional relationship between the semivariogram of at least second order stationary regionalized variable and its planar autocorrelation allow using autocorrelogram surface as spatial continuity of the original data. Thus, the planar autocorrelogram gives the complete geostatistical system of the measured data. Laplacian operator is a mathematical tool to determine the net recharge and discharge volume for a physical quantity at a given point. Grid contours generated with the operator coincide with the structural and heterogeneity characteristics of clastic sedimentary rocks, thus the method is applicable to indicate potential static flow surfaces or paths. Adoption of this method in coreflood experiments improves the comprehension and predictability of fluid motions in reservoir beds in micro scale. Displaying of HU data as isosurfaces in 3D emphasizes the process during a fluid fills a sandstone body up. This technique is more advanced than static flow images; because interval shifted 3D displaying generates images at discrete stages of HUs. Moving toward the higher HU values the smaller pore space displayed, which means the pressure needs to be higher to enter these pores.

Conceptual investigation of Closed System Utilization of High Enthalpy Geothermal energy - Environmental Impact

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Keywords: geothermal energy, heat transport, numerical simulation

The geothermal energy is energy obtained by tapping the heat of the Earth itself, this energy derives from the radioactive decay. Geothermal energy is a promising component of the renewable energy mix in the European Union.
Hungary has favorable geothermal conditions: while in other countries the temperature increases by 30-33 degrees Celsius per kilometer downward, this value is 42-56 degrees Celsius in our country. At the depth of 5,000 meters, rock (and water in the porous rock) temperature usually exceeds 180-300 degrees Celsius.

The most widespread way of geothermal heat exploitation in Hungary is groundwater production. The other methods are negligible in these days.

There are more than 5000 dry hydrocarbon holes in Hungary from 1000 m depth down to 6000 m. Based on water management considerations, national legal devices on environmental protection and to take notice of the rather high investment requirement, utilization of geothermal heat without groundwater exploitation is suggested.

The calculation of heat potential of geothermal energy resources requires hydraulic simulation of groundwater flow. The primary goal of the simulation was to evaluate the transmitted heat amount by convection. A deep trough of the Pannonian Basin was chosen as a study area

To investigate the heat (energy) and water balance of the area of interest, a numerical model was built using Processing SHEMAT code. Based on the spatial information of geophysical prospecting, the geometry of the strata was determined. Upon these data a simplified hydrogeologic scheme of the investigated area was established. The thermal properties of the investigated region are originated from the geothermal database of the country and based on several deep drillings of the site.

Using of neural network in porosity prediction (Beničanci field)

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Abstract

The Benicanci oil field, located in the eastern part of the Drava depression is still one of five main hydrocarbon reservoirs in Croatia. That makes very meaningful to plan and perform a whole new set of geological reinterpretations and improvements of field geological model. The application of the neural network approach in seismic attribute processing and finally reservoir porosity prediction is presented in the paper. The three seismic attributes were interpreted – amplitude, phase and frequencies making 3D seismic cube. This attributes were extrapolated at the 14 well locations, averaged and compared by the mean porosities. It made the network training. The network was of the backpropagation type. It was fitted through 10000 iterations, searching for the lowest value of correlation between attribute(s) and porosities and the minimal convergence. The best training was reached using all three attributes together, what indicated on tendency that neural networks like numerous inputs. Moreover, the previously interpolated porosity map was done using geostatistics, both Kriging and Cokriging approaches. The Cokriging approach, very interesting, included only reflection strength (derivation of amplitude) as secondary seismic source of information (compared by neural inputs of three attributes). It very clearly indicated on position of carefully and geologically meaningful selection of the network inputs for any reservoir analysis. Relatively smooth map, and rarely reaching of measured porosity minimum and maximum, strongly indicates on conclusion that neural estimation is more precisely than previously interpolations.

Keywords: *Seismic attributes, neural network, porosity, Drava depression.*

1. INTRODUCTION

The Benicanci oil field is located in the eastern part of the Drava Depression. It is still one of the five most productive hydrocarbon fields in Croatia. The reservoir is of massive type, lithologically represented by dolomitic and limestone breccias. The top of the structure trap is on 1699 m absolute Average porosity was 7.33%, initial water saturation 28.13%, and oil gravity 875.0 kg/m^3. Production started in 1972 and waterflooding in 1975. The field is today in mature production stage, explored and developed by totally 106 wells with 25 wells still in production stage. Following analysis was performed on data collected in 14 wells. In the analysis new porosity averages were calculated for reservoir interval as well as seismic attributes calculated from recently performed 3D seismic survey.

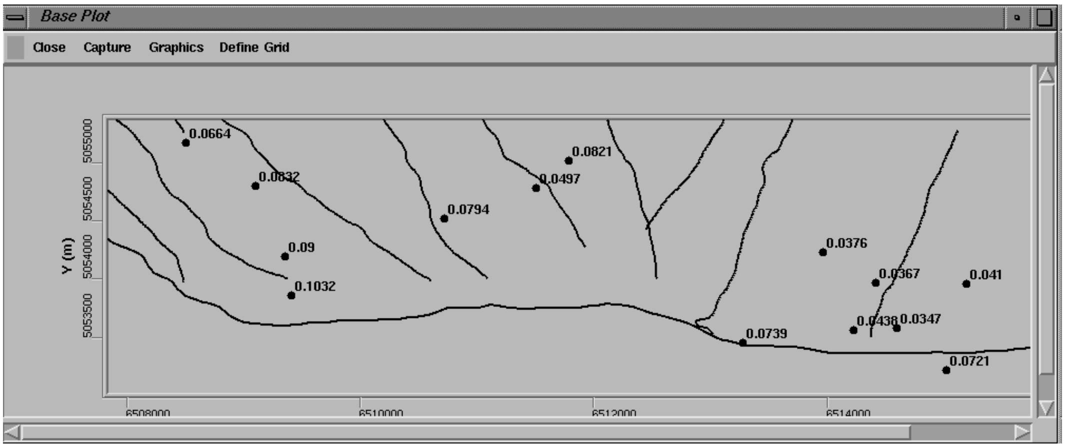

***Fig. 1**. Index map*

Porosity is selected as the important reservoir variable with high influence on reservoir volume, OGIP and finally production. The analysed reservoir belongs to the coarse clastic sediments of Badenian age (lithostratigraphically Mosti member). Seismic interpretation was performed for interval that begins at 20 m from the member seal and spreads to the member base or the well bottom has been monitored as reservoir (**Futivić and Pleić, 2003)**. Seismic attribute analysis was applied on 3D seismic data and extracted amplitude, frequency and phase were used for reservoir porosity mapping performed backpropagation neural network.

2. SEISMIC BACKGROUND

Seismic waves are reflected from layer borders and can be distinguished by receiving time, amplitudes, phases, frequencies and polarities. Every change in acoustic impedances on both layer planes will change the above parameters. Detail analysis of these changes would allow determination of structure, lithology or fluid saturation in reservoir layers (**Taner, 1992**).

Seismic trace is complex record of subsurface seismic wave arrivals presented as real trace on **Fig.2**. The associated complementary imaginary trace is calculated by Hilbert's transformations. The sum of amplitudes of real and imaginary trace is always equal to amplitude of complex trace. Such complex trace is used in further analysis and calculation of amplitudes, phases and frequencies, applying relevant mathematical operations in order to achieve reliable seismic trace analysis. It is important that input seismic traces are of good quality and containing minimal noise.

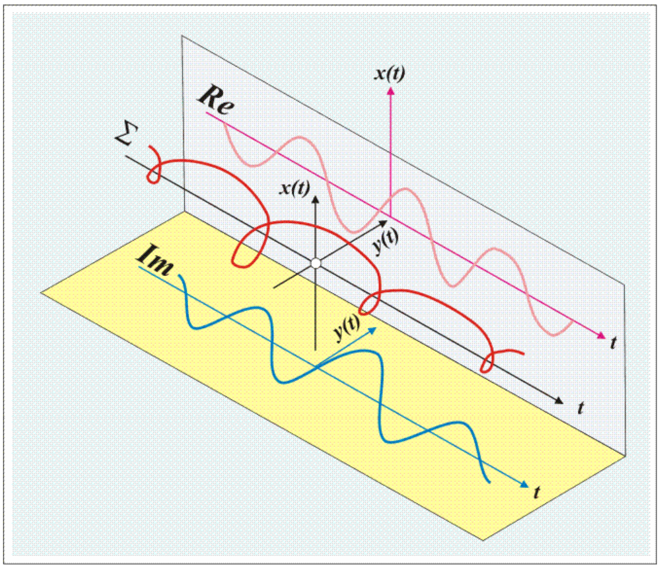

Fig. 2. *Real (Re), imaginary (Im) and complex seismic trace (Σ)*

Hilbert's transformation resulted in moving of all frequencies components of input – positive for -90° and negative for +90°. Assuming that ***x(t)*** is input signal, ***y(t)*** output signal, ***G(w)*** Hilbert's transformation in coordinate axes based on frequencies. Equitation (1) describing Hilbert's transformation of input signal ***H(x(t))*** in time-coordinate axes as:

$$x(t) \to G(w) = -j\,\mathrm{sgn}(w) \to y(t) = H(x(t)) \qquad (1)$$

Where are:

$j = \sqrt{-1}$, and

sgn (w) = + 1	for	*w > 0*
sgn (w) = - 1	for	*w < 0*
sgn (w) = 0	for	*w = 0*

If the amplitudes of complex function ***z(t)***, obtained from (1), there is possible to calculate values of instantaneous amplitudes ***a(t)***, phases ***f(t)*** and frequencies ***w(t)*** of the complex trace using:

$$a(t) = \sqrt{x^2(t) + y^2(t)} \qquad (2)$$

$$\phi(t) = arctg\left(\frac{y(t)}{x(t)}\right) \qquad (3)$$

$$w(t) = \frac{d\phi(t)}{dt} \qquad (4)$$

Every acoustic impedance change in layers directly influences their seismic reflection character and the detail analysis of such changes is the basis to study of reservoir status. Even small amplitude and phase anomalies can indicate on changes in lithology, thickness and fluid saturation. The changes in amplitudes, phases and frequencies became already reliable tool in rock physics study determination in oil reservoir, as schematically presented on **Fig. 3**.

Interpreted **amplitudes** can be used for determination of reservoir properties like porosity, gas accumulation, fluid contacts, lithological continuity and detection of over-pressured zones. It could be also detected very precise detection of unconformities, fault planes, stratigraphic barriers, water of CO_2 front progress etc.

The main advantage of **instantaneous phase** is simple observing of phase changes, without regard on amplitude values. Such phase transitions can be especially useful in interpretation of facies changes, unconformities, faults and stratigraphic relations.

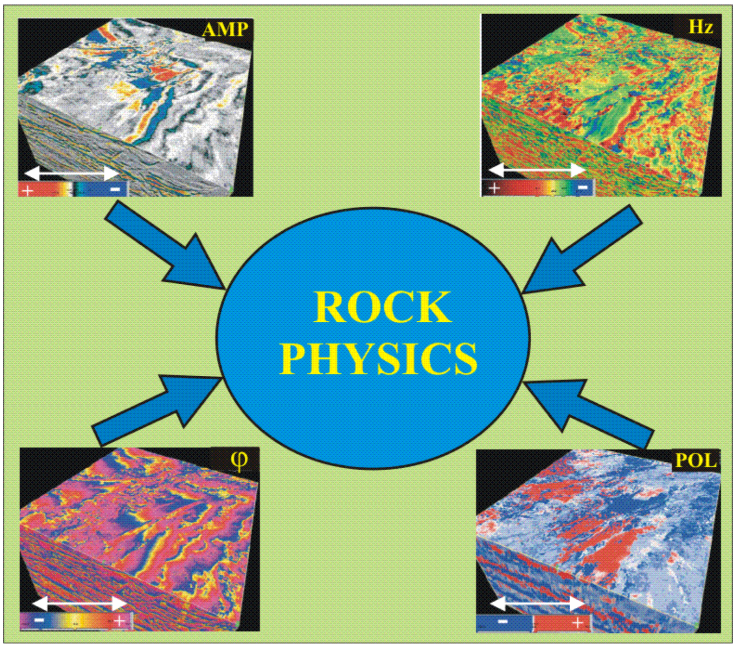

Fig. 3. *Seismic attributes analysis enables rock physics determination*

Frequencies can be calculated using correlations among sinusoidal and co-sinusoidal functions of different frequencies. Such correlation coefficients can be measure of frequency content in relative wide time interval. But *instantaneous frequencies* indicate on changes between particular time samples. This data can be used for lateral correlation of reflected seismic signals, detection of thin layers of small acoustic impedances, finding fractures characterised by extremely low frequencies, and sand/shale ratio calculation.

The combined and improved application of the several seismic attributes can make possible to select different facies zones in heterogeneous reservoirs, such it is Beničanci field reservoir of Badenian age. Moreover, such facies analysis can be indirectly performed, searching for the more appropriate spatial analysis of important reservoir parameter like porosity.

3. BACKPROPAGATION NETWORK

Generally, neural networks are modern tools with numerous purposes (**Anderson and Rosenfeld, 1989**). In the early days of artificial intelligence ROSENBLATT, employed at the *Cornell Aeronautical Laboratory*, was developed in the 1957 the machine called *perceptron*, based on memorizing pattern of human mind (**Rosenblatt, 1957, 1958**). Such machine could "learn" and represented prototype of neural network. Perceptron scheme included connections like that in associative memory.

The basic structure of the network is based on artificial neuron model. Such neuron is assembled from several inputs and single output. Each input is associated with related *weight* added to input value. Depending on result, the neuron could stay inactive or be activated. The values and conditions for activation are determined by *activation function*.

The way how specific number of neurons define network is described through *layers*. The set of selected neurons make *input layer*. Such inputs are modified through *hidden layers* and result is given in *output layer*. Hidden layers are not connected with information outside network, like inputs or output channels.

In general, *input layer* collect and distribute data loaded in network, and *hidden layer(s)* process such data, using activation function. Expression (5) represents set of operation performed on neuron, and equation (6) detects activation of neuron.

$$U_j = \sum \left(X_i \times w_{ij} \right) \qquad (5)$$

Where are:

j - *Number of neuron ;*

i - *Number of inputs ;*

X_i - *Value of input "i" ;*

w_{ij} - *Previously determined weight coefficient for input "i" ;*

U_j - *Value of output in neuron "j"*

$$Y_j = F\left(U_j + t_j\right) \qquad (6)$$

Where are:

F - Activation function ;

t_j- Target value for neuron “j” ;

Y_j - Layer output (or total output if it is last layer)

The value of output *(U_j)* is compared with conditions necessary for hypothesis acceptance *(t_j)*. Activation function *(F)* is eventually started based on this value.

Equitation (5) implied that previously are determined weighting coefficients, value of hypothesis acceptance, number of layers and number of neurons in each layer. It makes possible to get result of a neural network. The values of weighting coefficients and hypothesis acceptance are changed and modified in the period of network training (or learning).

Recognition of samples that only could be separated using linearity represents limits of a network based only on perceptrons. This limitation is prevailed by introducing of *back error propagation* paradigm (abbr. *backprop*). This algorithm extends the perceptron effect, using of large number of hidden layers. It is why term *the multiple layer perceptron (*abbr. *MPL)* is used.

Backpropagation algorithm means that network training includes determination of difference between true and wanted network response, i.e. means calculation of *error* that is backed in network in purpose of obtaining the optimal training. Such error is determined for each neuron and used for adoption of existing weighting coefficient and activation value. This corrective procedure is called *the backpropagation network* that describes the process of network learning and validation. It is repeated so many times while particular or total error is not decreased below the limit. After that, the training is over and the network could be applied for processing of new inputs. *The backprop* algorithm first processes inputs, checks output error and finally going backs on the same inputs. It is the most popular paradigm that is applied for neural network at all. Backprop of information in network always starts from output to inputs. Backprop is used in the multilayer networks, but often could be characterised with long lasting training. It is why the backprop using is limited for calculation without inquires for fast outputs. Such shortages in learning rate resulted from *the gradient descent* method that is used in the backprop algorithm. The backprop equitation is shown in Equations (7):

$$[w_i]_{new} = [w_i]_{old} + [LR] \cdot [transfer\_function] [correction\_term] + [momentum\_coefficient] [previous\_\Delta w] \quad (7)$$

Where are:

w_{new} - weighting coefficient of input (seismic attribute) in *"i-th"* iteration

w_{old} - weighting coefficient of previous iteration

Δw - difference between these two weighting coefficient

LR (η) - *learning rate*, indicates on level of using of transformation function (momentum coefficient) in each iteration. If LR=0 transformation function is not used and entire network is based only on applying of *momentum coefficient*.

Momentum coefficient (α) – this parameter defines how large is influence of result of previous iteration in instantaneous calculation.

Correction term – this value depends on differences between true (measured) and trained (by network) value.

Transfer function – there is several, and we used sigmoid shape expressed as $f(x) = \frac{1}{1+e^{-x}}$

In performed training the large influence have the values of *momentum coefficient* and *correction term*. Momentum coefficient defined the size of previous iteration influence on new estimation. Let us to explain geological meaning on the following example. Imagine the set of 1D porosity values 7.2, 7.0, 6.3, 5.7, 6.2, 6.5, 5.5, 5.2%. Generally, this array tends to minimum at the end. But there is also one local minimum 5.7% at 4th place. This network will recognize these local minima If network parameters are set very sensitive. In other case, the network will only detect general decreasing trend. The ***momentum coefficient*** is extremely sensitive for detection of *local minima*, and ***learning rate*** for detection of *general trend*. The third important parameter is ***correction term*** that represents differences between true ad modelled values. It is calculated for each *hidden layer*, and the network tries to decrease this differences through each the next iteration.

4. BENIČANCI FIELD NETWORK (POROSITY PREDICTION)

There were two datasets for the Benicanci field reservoir. The first one included 13 seismic (amplitude, frequency, phase) and porosity values averaged at the well locations. The second set encompassed the seismic raw data from seismic grid (16384 values in total).

The first dataset was used as training set for the neural network of the backpropagation type. Transformation function was of log-sigmoid type. There was selected the best network iteration, by the most appropriate weighting coefficient. Such network was used for porosity estimation from the second, exhaustive, seismic dataset. The final goal was to reach the **estimated porosity map**, which could be considered as improvement for any previously interpolated reservoir porosity map. The last interpolated porosity maps on the Benicanci field were obtained by geostatistics.

4.1. Insensitive network parameters fitting

The number of hidden layers in the network was 5. We tried to increase this number, e.g. up to 25, but such increasing did not improve obtained correlation between attribute and porosity (only for 0.001-0.01), but made the network very slow. The *learning rate* value was left on recommended 0.9, the *momentum coefficient* also on recommended 0.6. The network output was very similar for ranging these parameters from 0 to 1. The number of *iterations* was 10,000, but the output was not significantly differing even for 30,000 iterations.

4.2. Sensitive network parameters fitting

The most sensitive parameter was number of included seismic attribute in analysis in the same time. We tried to feed the network by single and multiple seismic attributes in the same training. The use of 2 or 3 attributes could be questionable procedure regarding physical meaning of such new "attribute". But obtained correlations are highly connected by number of included attributes. It is why we varied number of nodes in input layer between 1 and 3, combining amplitude, frequency and phase in new "complex" attribute.

The selected transfer function was log-sigmoid type. The second important value was *convergence criteria* ($\Sigma\varepsilon^2$). It played a role of the network stopping criteria. It the network calculated convergence value lower than selected value, the simulation will stop although iteration no. 10,000 was not reached. This value was set on 1 and only one the network reached lower value.

4.3. The network results

The quality of network training was expressed through correlation between porosity and included attribute(s), and the network's convergences criteria as the minimum reached by the backpropagation algorithm. Looking by different number of input network's nodes, the following results were obtained:

- Amplitude + frequency + phase = porosity - R^2=0.987 ; $\Sigma\varepsilon^2$=0,329;
- Amplitude + frequency = porosity - R^2=0.496 ; $\Sigma\varepsilon^2$=1,935;
- Amplitude + phase = porosity - R^2=0.603 ; $\Sigma\varepsilon^2$=1,740;
- Phase + frequency = porosity - R^2=0.820 ; $\Sigma\varepsilon^2$=1,090;
- Amplitude = porosity - R^2=0.250 ; $\Sigma\varepsilon^2$=2,730.

The presented results showed that porosity prediction can be done with any number of attributes. But, it is interesting that the highest correlation was reached using all three attributes together. Porosity inputs were in range 5.27-11.06%, but the estimation by the neural network had a tendency to make this variation narrower (remaining the limits). This is also often characteristics of geostatistics and regression.

Using only one or two attributes the estimation was artificially too high, e.g. pair amplitude-frequency led to average porosity close to upper limit. The problem with one-parametric estimation can be explained on amplitude. Physically, amplitude is the most "geological" attribute that could lead to good estimation of porosities in clastites. In our case, correlation of the pair amplitude-porosity is very low (0.25) and the network is poorly trained ($\Sigma\varepsilon^2$=2.73). The lower amplitude led to lower porosities, but the problem was *the differences* between these estimations. For example, amplitude value 1200 is paired by porosity of 5.27%, then 1472=7.3%, 1669=8.15%, 1842=8.16%, 1990=8.17% and 2107=8.16%. The change is not a linear.

The best porosity estimation was obtained using all three attributes. The estimated porosity varied in wide range, respecting the limits of input (5.27-11.06). Unfortunately, the input dataset was too small to interpret if the estimated porosities also respect input distribution.

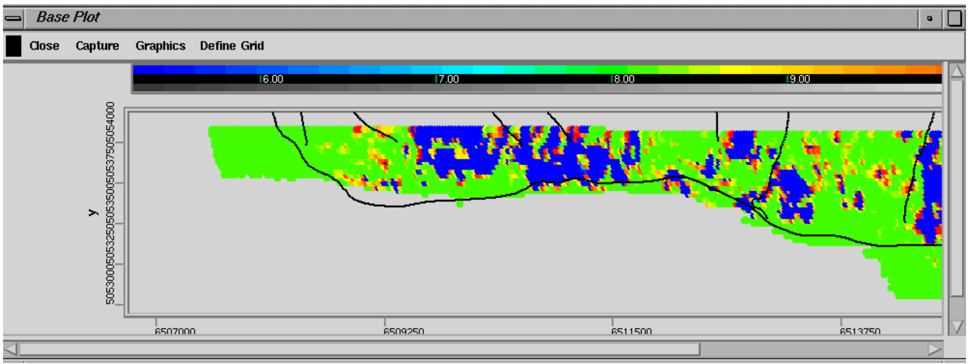

Fig. 4. *The neural network porosity map at the Benicanci field (range 5-10%)*

Graphically, the results are presented by the map obtained by the SigmaView^{TM} program (Landmark application). The problem was encountered by importing the network results and there was only possibility to interpolated new one neural map at the southern part of the field (**Fig. 4**). It could be compared also by geostatistical porosity maps interpolated in 2003 at the same field (**Malvić and Đureković, 2003**) and shown at **Figs 5 and 6**.

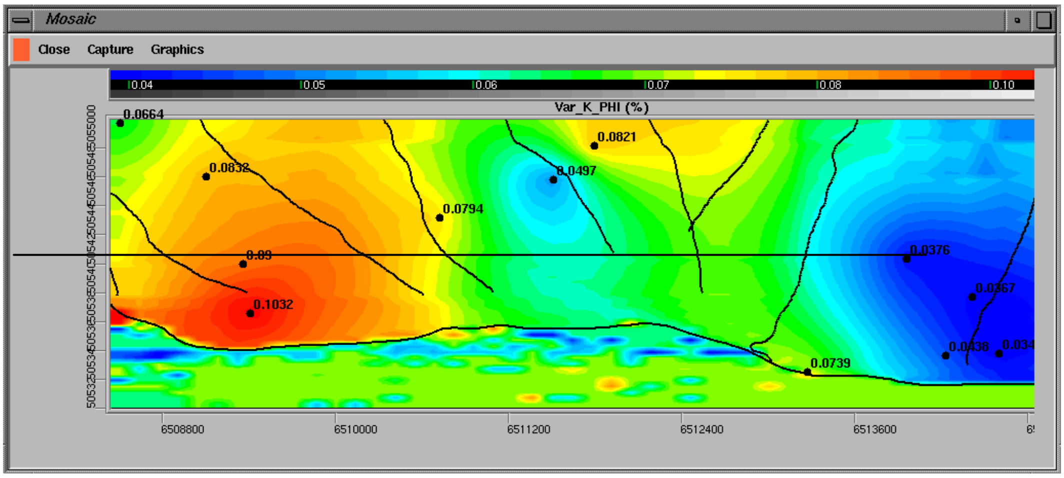

Fig. 5. *The Kriging porosity map at the Benicanci field (range 4-10%)*

Moreover, it was interesting that in Cokriging application as the secondary attribute was selected only single attribute. It was reflection strength, derived from amplitude. The correlation was calculated using Spearman rank coefficient with value **r'=-0,64.** Even so, it was improvements compared with Ordinary Kriging results (compared via cross-validation). It means that neural approach “likes” more variables, and sometimes can combine physical measurements that are very slightly connected through their nature. It needs to be carefully used.

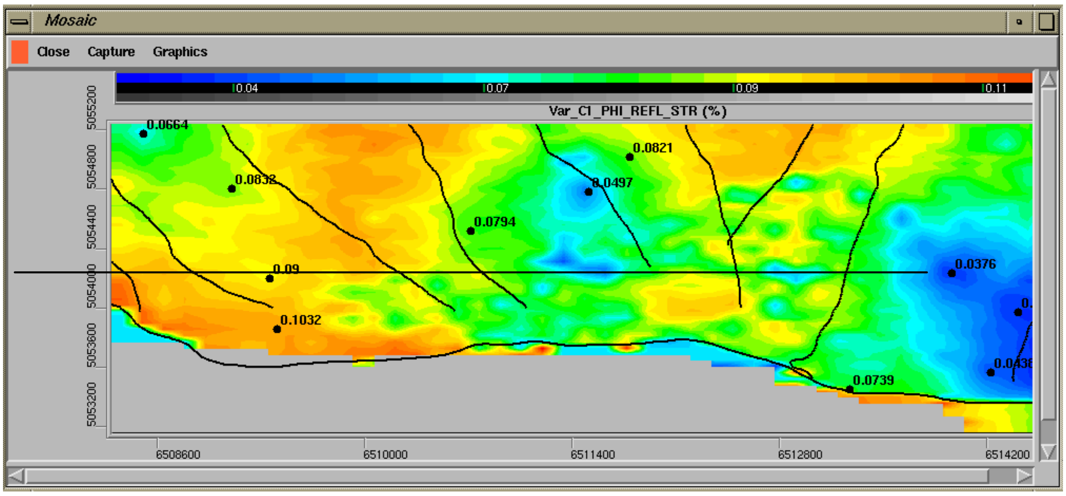

Fig. 6. *The Cokriging porosity map at the Benicanci field (range 3-11%)*

5. DISCUSSION AND CONCLUSIONS

Obtained results show that seismic attributes could be valuable additional source of information that could feed the neural network. Seismic could be base for reservoir parameters prediction, especially for porosity what is shown in this study.

The quality of the network could be estimated from two parameters – correlation coefficient (R) and convergence criteria and the reached minimum ($\Sigma\varepsilon^2$). The better network will be characterised by higher coefficient and lower convergence.

Based on the results presented, the following conclusions can be drawn:

- The best training results are obtained when all three seismic attributes (amplitude, frequency, phase) were used;
- The reached correlation is R^2=0.987 and convergence criteria; $\Sigma\varepsilon^2$=0,329;
- These values can slightly (a few percent) differs in every new training, what is consequence of stochastic (random sampling) is some process of the network fitting;
- It could be geological tricky to explain, because amplitude is often correlative by porosities, but frequency and phase much harder can describe rock pore system;
- It also indicates that neural network very favour the numerous inputs, and it need to be carefully evaluated which variable can be meaningful neural input;

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The neural analysis was performed using Neuro3 – Neural Network Software. It is freeware E&P Tools published by the National Energy Technology Laboratory (NETL), owned and operated by the U.S. Department of Energy (DOE) national laboratory system. The system demonstrates ability to learn, recall, and generalize from training patterns or data.

Geostatistics in climatology

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Keywords: wind field modelling, geostatistics, Sequential Gaussian Simulation, uncertainty of expected value of wind speed, wind profile, GIS

Due to the ever increasing anthropogenic environmental pollution and the worldwide energy claim, research and exploitation of environmental friendly renewable energy sources becomes more and more important. Developed countries, especially the European Union, support systems based on renewable energies, in this way exploitation of wind energy.

Our research is on the spatial allocation of possible wind energy usage. We would like to carry this out with a self-developed model (Complex Multifactoral Polygenetic Adaptive Model = CMPAM), which basically is a climate-oriented system, but other kind of factors are also considered. This model facilitates the choice of those regions, where exploitation of the available wind energy would yield profit. The model consists of several sub-modules, the most important one of them is the wind field modelling (CMPAM/W). Our research focuses mainly on this sub-module.

This wind field modelling comprises methods and calculations of atmospheric physics, GIS and geostatistics and its aim is to supply information on wind field for system planning and economic efficiency calculations, which can not or can hardly be supplied by using other methods. Geostatistics provides better opportunities than mathematical statistics and makes better and more precise spatial analysis possible. Furthermore we could find the answer for new and important questions that could not be answered with mathematical statistics because Geostatistics in contrast with mathematical statistics uses regionalized variables with structural and eratic features and works with dependent sampling method. Mathematical statistics uses probability variables and works with independent sampling. Geostatistics deals with spatial structure of the data and this field of science is able to measure variability and heterogeneity in this structure and to use them in estimating of the grid points.

Using optimized variography and algorithms as well as sequential Gaussian simulation we acquired our wind field simulations for various heights. The resolution of the CMPAM/W grid system is 4 km^2 and provides the following information for each grid: expected value of the wind speed, uncertainty of the wind speed and wind potential value. These wind field simulation results were used in the entire CMPAM.

Cyclic patterns of Quaternary fluvial deposits in Körös Basin and Jászság Basin

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Keywords: fluvial sedimentology, Quaternary, sediment cycle, trend analyse

According to several investigations of the geological survey of the Great Hungarian Plain so many new information appeared from the Late Neogene sedimentation of this region. It is well known that the Quaternary fluvial deposits of the Pannonian basin shown cyclic patterns. Despite the considerable treatment of the late neogene and Holocene suites this cyclic behaviour has not cleared up properly yet except for some studies in the last few years. The reason for that is the difficulty of the explanation, because these cycles were made by both of the climatic controls and the complex relationships of the depositional environments. The main aim of the study is try to give a new point of view in examination to the Quaternary sediment cycles without terms of stratigraphy.

A theoretical model has been formed for the comprehension of these relationships. The accurate change in the astronomical control of the climate in the middle of the Pleistocene changed the condition of the sediment deposition. The point of departure of this study is the succesion always reflects the changes but it shows different degrees in different fluvial environments.

During the Quaternary, the climate and tectonic control, allocyclic effects (Miall, 1996) influenced fluvial sedimentology patterns, but in the local depositional environment, the autocylic effect which is characterized by the natural fluvial sedimentation, could cancel their impressions to the texture. In connection to the texture of sediment rocks, this study also examine the relationships between magnetic susceptibility(MS) and average grain size(Mz) to get new information about allocyclic control, which could be represented by the MS values as it is obvious for the researching of loess. Of course the average grain size datas have to show the real change horizonts in transportation capacitiy of the rivers, and the horizonts of the autocyclic patterns. Methods like trend analyze, and cross correlation was good choice for solving these problems.

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Classification types of urban heat island patterns in case of two Hungarian cities

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Keywords: maximum UHI, normalization, cross-correlation, classification types, wind effect

The most obvious climate modification effect of urbanized areas is their temperature surplus compared to the environment, called urban heat island (UHI). The UHI intensity has a typical daily course, reaching its most characteristic development usually around 3-5 hours after sunset. The aim of our research is to study the distribution of the UHI in the town in the above-mentioned time, when the heat island phenomenon reaches its greatest extent.

Research covered urban and suburban parts of Szeged and Debrecen (Fig. 1). The research on the daily maximum UHI intensity is based on results of mobile measurements taking place in a one-year period, between April 2002 and March 2003. Both the 35 measurement days in Szeged and the 30 in Debrecen provide an adequate background to gain detailed information on the development of the maximum UHI even in various different weather conditions.

In the course of our comparative investigation on the UHI structure, it appeared to be more useful to study normalized intensity (dimensionless value) than absolute intensity (ºC), since in this case it becomes possible to compare the spatial structure of measurements or settlements significantly differ in the UHI intensity. Another advantage of the application of normalized values is that the roles of different cases are balanced, that is the weights of cases in the average are the same. The pattern of the average heat island appears to show a rather similar, almost concentric shape in case of both towns. More significant alterations from this shape can be recognized only in case of different types and densities of built-up areas (Fig. 1).

Concerning the classification, based on the cross-correlation of normalized and constructed cases, in Szeged 6 and in Debrecen 5 different types of the UHI patterns could be distinguished. While investigating the individual types it became clear that behind the differences between the statistical groups primarily the effect of one component, namely the wind could be recognized.

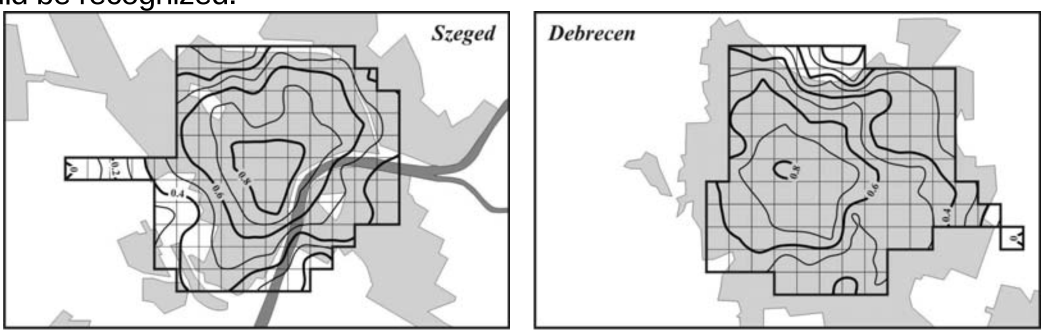

Fig.1: The studied areas and the spatial distribution of annual mean normalized maximum UHI

The influence of Groundwater Fluctuation to the natural habitat types in southern Kiskunság

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Keywords: hydraulic regime, potentiometric level, duration line, vegetation pattern

The dune slack meadows are groundwater dependent ecosystems, therefore the knowledge of groundwater systems is one of the most important aspects in the protection of ecologically valuable areas. In the last decades, a considerable groundwater decrease was detected in the Kiskunság and perhaps the vegetation of dune slack meadows is endangered because of this process, but there is no evidence of this in the scientific literature. Information about the hydrological conditions of dune slack vegetation is needed to understand the natural processes and to plan habitat management or restoration.

The main goal of this study is to reveal the connection of hydrological backgrounds and vegetation pattern.

Two stands of about 100-100 ha large dune slack meadows were chosen for detailed botanical and hydrogeological investigation: Csipak-semlyék (CS), and the so called „Magic" Meadow (MM) (this nickname was given by botanists because of its unusual richness in protected plants). Both area are involved in the Natura 2000 network.

The studied areas are situated near to the midline zone of groundwater flow system regionally, but they bear marks of discharge zone locally.

According to the pressure-elevation profile computed from the data of deep wells situated in similar elevation and position than the two studied sites the vertical pressure gradient is similar to the hydrostatic gradient. This indicates through-flow system. But in the surroundings of CS region the gradient is higher than the hydrostatic one from the depth of -500 (a.s.l.) m downward, thus the direction of vertical movement of the water is ascending in this zone. To determine the characteristic of groundwater levels during the study period two observation wells were drilled in both study area.

The shape of the duration lines of the piezometers indicated that the two study areas belong to different hydraulic regimes. In MM site the slope of the duration line is deep, but in CS site the high water period is prolonged, occurs circa 75 % of the year. If we take into consideration the potentiometric level of the shallow groundwater as upper boundary condition in our hydrodynamic model, than the studied areas behave as discharge areas. The difference between the investigated areas lies in groundwater travel paths: while CS belongs to the intermediate flow system, till MM belongs to the local flow system

Application Possibilities of Electromagnetic Parameters in Environmental Protection

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Summary

The paper summarizes the primer (frequency-dependent components of electric and magnetic field intensity) and secondary (frequency-dependent complex resistivity, component of the impedance tensor, phase of the impedance, etc.) electromagnetic (EM) parameters and analyses their applicability in the environment examination and environmental protection.

An own-developed 3D hybrid-integral equation electromagnetic field modeling method and a software system as well as an inversion algorithm based on global optimization using the modeling procedure will be presented.

The horizontal and vertical contour maps of EM parameters were produced by the 3D EM modeling method in case of a subsurface oil contamination and some municipal waste sites. By means of these parameter images, the borders of the contaminated volumes can be determined (basement, cover, lateral extension) and the optimal frequency domain of the field measurements can also be projected.

For the integrated visual and numerical analysis of EM parameters an Intergraph GeoMedia GIS based geoinformatical system was developed. The operation of this system is shown in case of a GIS database created by model computation of a subsurface oil contamination and cavity.

The achieving of these results was supported by the Hungarian Scientific Research Found (project No. T046765) and the Intergraph RRL programme (http://synergy.intergraph.com/orl/member.asp?track=402291). The authors would like to thank for the support.

Az elektromágneses paraméterek környezetvédelmi célú alkalmazási lehetőségei

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ÖSSZEFOGLALÁS

Az előadás összefoglalja a primer (frekvenciafüggő elektromos és mágneses térerősség komponensek) és szekunder (frekvenciafüggő komplex ellenállás, impedanciatenzor komponensek, impedancia fázis, stb.) elektromágneses (EM) paramétereket és elemzi a környezetvizsgálati-környezetvédelmi alkalmazhatóságukat.

Bemutatásra kerül egy saját fejlesztésű 3D hibrid-integrálegyenletes elektromágneses térmodellező módszer és szoftverrendszer, valamint az ezt felhasználó globális inverziós eljárás.

A 3D EM modellezéssel felszínközeli olajszennyeződés és kommunális hulladéklerakók esetében számítottuk ki az EM paraméterek eloszlásképeit. Ezeknek a paraméterképeknek a segítségével jól kijelölhetők a szennyezett térrészek határai (fekü, fedő, laterális kiterjedés) valamint megtervezhető a terepi mérések optimális frekvenciatartománya.

Az EM paraméterek képi és számszerű integrált elemzésére Intergraph GeoMedia GIS alapú geoinformatikai rendszert fejlesztettünk ki, melynek működését olajszennyezés és üregkutatás eseteire összeállított térinformatikai adatbázison szemléltetjük.

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Morfológiai sajátosságok szerkezetföldtani jelentősége

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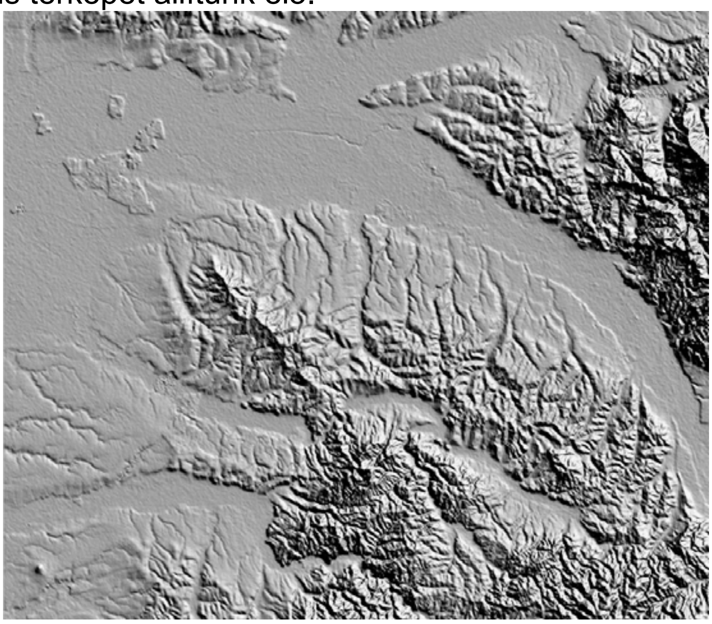
Keywords: : elevation models, digital image processing, lineaments

The present article shows a possible interpretation of the Shuttle Radar Topography Mission data on Dealurile Pogănişului Banat region (Romania). Based on morphologic elements (valleys and crests/highs) and with the use of digital filtering we compiled the limeament map of the perimeter. We concluded a scenario about a possible tectonic evolution of the regions. Based on this Dealurile Pogănişului we consider to be the dextral stike-slip fault correspondent for the sinistral strike-slip fault system identified earlier on the Podişul Lipovei. In the same time we compared these footprints with some available tectonic maps.

Jelen előadás egy radarbázisú domborzati modell, az SRTM a Pogányosi-dombságot (Szákosi-erdő) ábrázoló területről szól. A tavaly (2006-os Sepsiszentgyörgyi EMT-BKF) bemutatott Lippai erdőtől délre eső terület (SRTM) morfológiai elemzésével (digitális szűrésekkel) egy lineamens térképet állítunk elő.



Eredményként vázoljuk a két terület egy lehetséges szerkezetföldtani fejlődéstörténetét, amely alapján azt állítjuk, hogy a Pogányosi-dombság tektonikailag a Lippai-erdő térségében azonosított balos oldalelmozdulás vele egykorú jobbos változata. E fiatal, vélhetően negyedkori, szerkezet alakulás szoros kapcsolatban lehet a Ruszkai-havasok fejlődéstörténetével. Ugyanitt, az érintett területekről készült és számunkra is elérhető tektonikai térképekkel is összevetjük a lineamens térképünket és e távérzékelés alapján született elképzelésünket.

Ez alapján újabb lépést tettünk e területek, makro-szintről mikro-szint felé történő, globális tér-informatikai adatokon alapuló, új jellegű vizsgálata felé. Ennek célja a korábbi kialakult tekto-nikai kép egyezése a linea-mensekkel és egy tervezett terepi felvételezés segítése, az egyes lineamensek esetleges megerő-sítése szerkezeti elemekként (vetőkként).

The Role of Permeability Tensor in Modelling Fluid Potential in case of Fractured Reservoirs

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Keywords*: Permeability tensor, REV, porosity, fracture network*

In order to involve fractured medium in a standard porous hydrodynamic model (e.g. MODFLOW), it is necessary to define some specific parameters of the fractured rock mass. The most essential data are the elementary volume above which the rock body has uniform hydrodynamic properties, fractured porosity values as well as the horizontal and vertical coefficients of the permeability tensor.
Because representative elementary volume (REV) is out of the range of core sample measurements, in case of fractured rocks porosity and permeability cannot be measured directly. That is why hydrodynamic parameters usually are determined using simulated fracture networks. To do this, the REPSIM software was used, which generates a 3D fracture system using a fractal geometry based DFN (discrete fracture network) algorithm involving input parameters such as fractal dimension of the fracture midpoints, length and aperture distribution of the faults as well as their dip and strike data.
The primary goal of the present study was to analyze the fluid potential of fractured crystalline reservoirs of the Pannonian Basin. The study area is the Szeghalom dome that consists basically of amphibolite and gneiss. Results of previous simulations infer that amphibolite has a connected fracture network with better fluid flow properties, while gneiss can hardly conduct fluid and is characterized by very low porosity.
Using a REPSIM-based fracture network model first porosity was calculated and according to these data REV size was determined for both actual rock types. In fractured rocks the orientation of conductive faults assigns the direction of fluid flow, so the intrinsic permeability tensor must be determined. In the REPSIM code it is calculated following the slightly modified algorithm of Oda (1985) and Koike & Ichikawa (2006). In this approach, comparing the Darcy law and the cubic law, permeability tensor can be computed as $k_{i,j} = \frac{1}{12} \cdot \left(P_{kk} \cdot \delta_{ij} - P_{ij}\right)$,where δ_{ij} is the Kronecker symbol and $P_{kk} = P_{11} + P_{22} + P_{33}$
Applying the computed permeability, porosity and maximum REV size data of the two different lithologies, a reliable hydrodynamic model of Szeghalom dome is presented.

Methods for Determining Frequencyspectrum Reducing the Effect of Measuring Noise

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***Keywords**: Fourier transform, DFT, inverse problem theory.*

Fourier transform is one of the most frequently used operations in data processing. In its practical use the input data are measured in a set of discrete time points and the transform itself is called Discrete Fourier Transform (DFT), performing a projection of the data from time domain to frequency domain. In the case of DFT the Fourier transform is determined by solving a complete set of inhomogeneous linear algebraic set of equations. In this projection the noise contained by the data is also spreading onto the Fourier transform, so the operation is relatively sensitive for noise. It is the same problem with Fast Fourier Transform (FFT) which makes the computation faster, however, yields exactly the same result as DFT.
The common way of reducing the influence of noise is using much more (measured) data than necessary for the exact mathematical solution. In the field of inverse problem theory this is the case of the so-called over determined problem. Problems like this have no exact mathematical solution, but we can find an optimal solution in practical aspect. In the inverse problem theory there are efficient tools to handle highly noisy data sets (containing even outliers). Because of this reason it can be expected that the noise sensitivity of the Fourier transform can efficiently be reduced if we consider it as an inverse problem. In the presentation two methods are proposed for the determination of the Fourier transform by solving an inverse problem. Two solutions are presented using the simple Gaussian Least Squares and the Iteratively Re-weighted Least Squares (with Cauchy weights) methods.

Characterization of the structural uncertainty in the case of a South-Hungarian HC-reservoir

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Keywords: seismic interpretation, velocity modeling, geostatistics, depth conversion, uncertainty.

The most uncertain step in a reservoir characterization workflow is to define the structure of the reservoir. Seismic data interpretation is widely used to do this task in the HC upstream industry.

Uncertainties of the seismic based reservoir geometry can be grouped in two classes:

- Time domain data uncertainties
- Uncertainties of the velocity model

In this presentation I would like to show the main types of structural uncertainties and I would like to characterize the volumetric uncertainty using SGS in the case of a South-Hungarian CH reservoir.