

## New Access to Old Electrical Log Interpretation in Oil and Gas Wells

### Nov pristop k interpretaciji konvencionalne karotaže naftnih vrtin

Jasna SOVILJ-LEGČEVIČ<sup>1</sup> & Velimir TURK<sup>2</sup>

<sup>1</sup>Kranjčeva 8, 9220 Lendava, Slovenia

<sup>2</sup>Tomšičeva 12, 9220 Lendava, Slovenia

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*Ključne besede:* enotno polje, točka infleksije, kvantni koeficient, tenzor, interakcija, spirala

#### Abstract

Bases of new old electrical log interpretation are quantum physics, string and unified field theory, Euler's number ( $e$ ) and Ludolf's number ( $\pi$ ), quantum coefficient of cosmic constant ( $\bar{K}$ ) and all well-known methods of log interpretations. We are interpreted old electrical log so that looking for interactions of preons in unified field, because they behave as visible and/or invisible parameters in phase equilibrium respectively they are already stored as space-time data relation in generating rocks, paragenesis of fluids and changes in PVT-conditions.

When you interpret naturally phenomena with statistic methods you receive very incorrect insight of reality preon interaction relation for parameters in phase equilibrium, for instance in corrections of SP and  $R_t$  for thickness of clean sandy component and simplify parameters on standard conditions ( $R_w$ ,  $R_{mf}$ ...).

#### Kratka vsebina

Osnove nove interpretacije konvencionalne karotaže so zakoni kvantne fizike, teorija "vezalk" in enotnega polja, Eulerjevo ( $e$ ) in Ludolfovo število ( $\pi$ ), kvantni koeficient kozmične konstante ( $\bar{K}$ ) ter vse znane metode obdelave karotažnih meritev. Konvencionalno karotažo interpretirava z ugotavljanjem medsebojnih prežemanj "elementarnih delcev" - preonov v enotnem polju vidnih in/ali nevidnih parametrov v faznem ravnovesju, oziroma shranjenih v prostorsko-časovnem razmerju nastanka kamnin, parageneze fluidov in PVT- pogojev.

Pri interpretaciji naravnih pojavov s statističnimi metodami dobimo napačno predstavitve medsebojnih prežemanj preonskih razmer parametrov v faznem ravnovesju, kot so npr.: popravki SP in  $R_t$  za debelino čiste peščene komponente ter poenotenje parametrov na standardne pogoje ( $R_w$ ,  $R_{mf}$ ,...).

#### Introduction

Usual access to log interpretation is how to eliminate fixed component from phase and phase equilibrium with corrections or to stress some others conditions, for instan-

ce nomograms, corrected factors for some changes of thickness fixed lithological components, mud, type of tools, stretching of line and so on. As since the phase equilibrium is at the same time in visible and/or invisible preon interaction relation all compo-

nents and phases, you can really lose that phase equilibrium, if you don't take into consideration.

Log data are stored as space-time data relation of parameters or there are information quanta (first edited in this paper) of preon interaction relation. It means, that new phase equilibrium, which is generating during drilling time doesn't exclude previous phase equilibrium. That is why we try to prevent elimination of any components from phases and phase equilibrium with trying to interpret existent old electrical log on the other way. On the basis of the preon interaction theory and unified field one we try to define known visible and/or invisible preon interaction relation of components and phases within/without fixed phase equilibrium and received values to compare with:

a) Drilling data (mud logging, shows of hydrocarbons - UV,  $\text{CHCl}_3$  and chromatography, drill-stem tests, logging),

b) Laboratorial analyses and

c) Production data (HDM).

What is preon? Preon is hypothetical entity, postulated as the building blocks of leptons and quarks. There is no experimental evidence for their existence, nor is there likely to be with the energies of current accelerators (I l l i n g w o r t h, 1975). Kezele (1994) said: "Preons (Fig.1) proceed from connection two particles or events. The first particle is composed from two preons. That two preons are reciprocal connected with changing still one, which is the force or "glue" keep them together."

After that appears problem in our conception of preon interaction existence and connections between micro and macro Universe, what we believe. Because until now preon existence is questionable, this paper

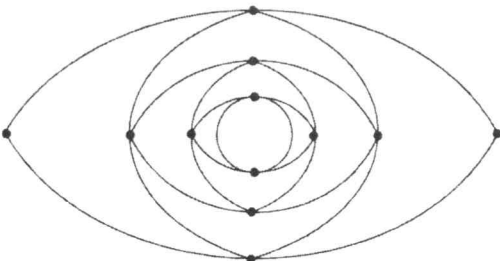


Fig. 1. Mechanism of binding preons  
(after Kezele, 1994)

tries to verify its reality in visible and/or invisible preon interaction relations of parameters in old electrical log interpretation. We use it as bases for stored phase equilibrium information quantum.

Besides nature knows only defined phase equilibrium and definitive values of components and phases (B o š k o v i ć, 1763: "... there is nothing that will be exist as current infinite, however exist only possible as string of definitely things, which are stretching in infiniteness."). So infinite values of Ludolf's number ( $\pi = 3,14159...$ ) and Euler's number ( $e = 2,71828...$ ) don't indicate defining phase equilibrium. We are defined according to preon theory "transcendental numbers" (first edited in this paper as authors' original idea): Ludolf's number  $\Rightarrow \pi = (3! \times (4^3 + 3)) / (4^3 \times 2!) = 3,140625$ , as basic reach spin unified field or spiral shift at symmetry break level and every quantum field polarity in preon interaction within unified field and Euler's number  $\Rightarrow e = (1! + 2!)^{2!} - (2! \times \pi) = 2,71875$ , as basic maximum possible preon interaction spin of every quantum field in unified field. Likewise it is very important to define elementary particle relations of matter/energy and interaction forces in unified field. At the same time (first edited in this paper as authors' original idea) they behave as inflection points by Huygens' principle (quadruplicity of nature) and Riemann's spheres in Fibonacci spiral (undulatory part of micro and macro Universe) and linear (corpuscular part of micro and macro Universe) motion interactions. Because "...nature has rightly continuum only in motion and in all others condition is only vision." (B o š k o v i ć, 1763) this relation is nature reality of all phenomena in Universe. Spiral motion by superstring theory (first edited in this paper) is result of electromagnetic, weak, strong and gravitation forces in spherical interference. We are defined this (first edited in this paper as authors' original idea) with Fibonacci numbers (Fig. 2) and Lissajous graph oscillating motion in done stretching and contracting Hamiltonian function.

It means, that mode of defining preon interaction relation all components and phases with transcendental numbers, what we done, is really defining (first edited in this

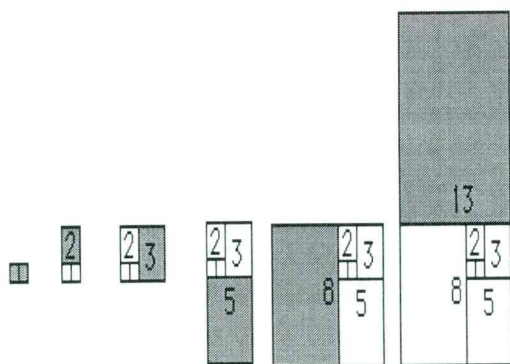


Fig. 2. Fibonacci numbers and spiral motion (<http://www.geom.umn.edu>).

paper as authors' original idea) preon isotropy in discontinuum phase equilibrium outside at sheaf interaction contact (more phases or  $2\pi/e$ ) towards inside influential zone fixed phase ( $e/2\pi$ ).

So we have interpreted 12 wells with that method, that used only those points on old electrical log of every well, if they have either production testing or coring interval data with other additionally data. Wells are select by chance from complete production and partly exploration area, which cover Nafta Lendava: Petišovci production field (1 to 7), Murska Sobota-Filovci area (8 to 11) and Goričko (12) - Table 1.

### Analysis of Old Electrical Log

Classical interpretation of old electrical log haven't give you all parameters, especially when you have faulty data, that you need for correct interpretation well data, therefore we must try to interpret it on other way.

Basic starting-point for our method is:

1. Universe is complete and uniform.
2. Preon interaction relation of parameters has elementary particles characteristics in visible and/or invisible forms (first edited in this paper as authors' original idea).
3. Preon quanta values are always stored, as space-time data.
4. Spiral motion is the basic motion in Universe.

If all natural phenomena are reflections

of dynamic preon interaction relations of components and phases regardless of its action directions and with its renovation ability (information quantum), then every phase equilibrium is preon interaction relation in unified field (first edited in this paper as authors' original idea). Because all characteristics of gravitational, electromagnetic, weak and strong interactions by unified field theory are incorporated in complete and uniform field as visible and/or invisible characteristics of every its parts, then in the same time that connect all phenomena in Universe and express reality of dynamic preon interaction relations of components and phases in every phase equilibrium. Otherwise it (first edited in this paper as authors' original idea) that permanent preon interaction relation of components and phases discontinuum (different preon particles - enthalpy group) towards component and phase continuum (inflection points - entropy group) is in exactly fixed energy equilibrium their Lissajous spiral oscillating motions (Gibb's free energy principle). Then SP,  $R_t$  in  $R_l$  as parameters only exist in preon interaction relations. Because environment circumstance is part of unified field fixed with phase equilibrium, more components and phases make it within anisotropy and without isotropy, respectively preon is expressed with inflection point at Lissajous graph spherical spiral interference of electromagnetic, weak, strong and gravitation forces. Then we can suppose that in unified field no exist homogeneous circumstances. Harmony is only in one point, inflection point. Interference relaxation of invasion zone proceeds from drilling subsequently influence on drainage area relaxation. Otherwise differently in old electrical logs every deviation expresses new phase equilibrium (Fig. 3) with old one elements. Still it has (first edited in this paper as authors' original idea) tensor anisotropy characteristics or one coordinate set of compound field group transformed to another elemental field from anisotropy/discontinuum to isotropy/continuum in space and time discontinuum and has isotropy of equilibrium touch or inflection in every point at logs. Total potential as old and new potential interference receive "annihilation touch (first edited in this pa-



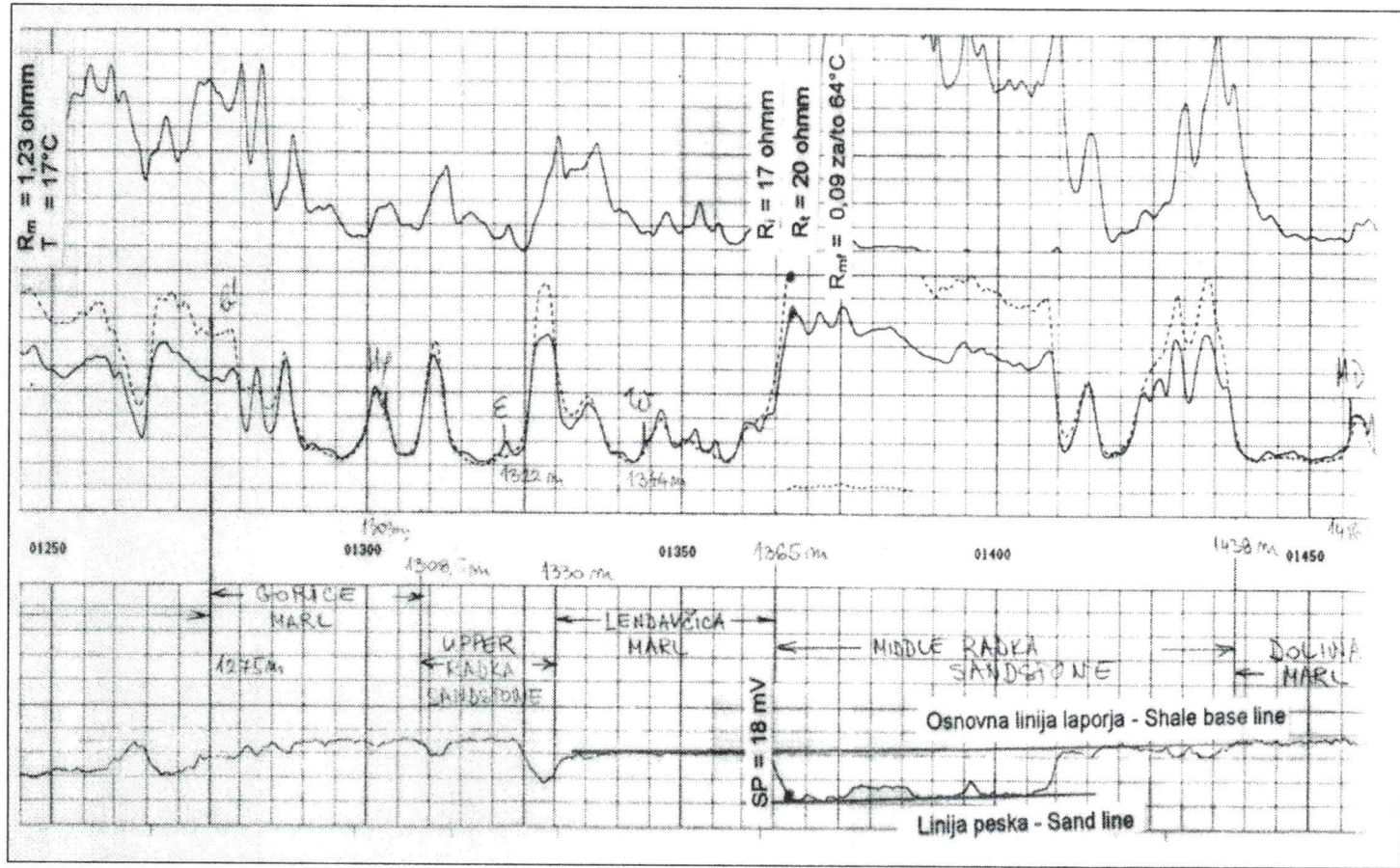


Fig. 3. Phase equilibrium with anisotropy characteristics and equilibrium touch isotropy (after NAFTA Lendava).



per as authors' original idea) or potential reach with regard to preon interaction relation between  $E_{PSP} (\Leftrightarrow E_{SSP})$ ; (Fig. 1, 4 and 5) for visible and/or invisible phase equilibrium in inflection point. It means, that exist wrong synonymous of potential and/or equipotential surface (Fig. 6). In the whole space (first edited in this paper as authors' original idea) there are equipotential surfaces only around the interaction center of phase equilibrium or in only one point with covariant and contravariant components in tensor field for every single point or simply inflection point (entropy group ability). Preon interaction relation between  $e$  and  $2\pi$  (first edited in this paper as authors' original idea) explain that inflection point in reality discontinuum of Riemann spherical space at Lissajous spiral with regard to exactly fixed equilibrium isotropy in fixed point. When you are logging spontaneous potential and specific resistivity, you surely can't see average but total values as visible and/or invisible reflections of state equilibrium all phases and components. Inflection point represents defined preon interaction relation states equilibrium with zone of transition.

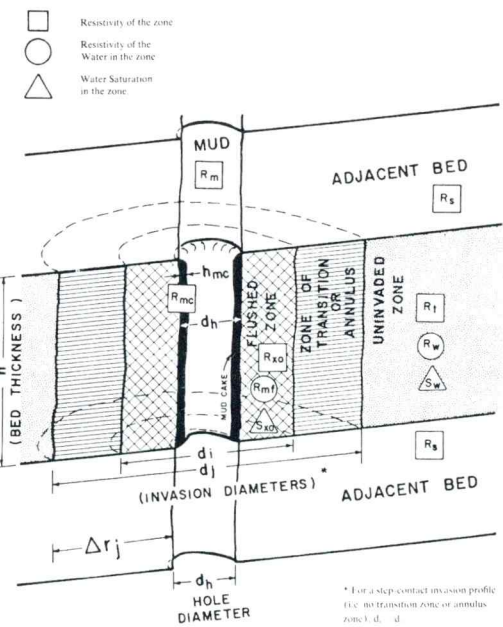


Fig. 4. Idealized influences in borehole without really preon relation indications (after Asquith & Gibson, 1982).

Relations, who are generating as to depth, express visible or/and invisible state of equilibrium changes of all present phases and components. Your only task is to recognize really preon interaction relations. The only difference as to depth is length of line stretching with hanging tool, but it also expresses exactly preon interaction relation. If you are adding any phase or component in system, for instance mud, new state equilibrium is received as such that depend of reach challenge interaction. In the same time you are receiving changed and unchanged ( $R_i$  in  $R_t$ ), visible or/and invisible data. Therefore defining preon interaction relation must be, if you looking spaciouly, consisting equally direction or viewing angle of treatment in unified field. If you don't make it so, you will get mathematical relations in collision. Then it is important, that we (first edited in this paper as authors' original idea) define such preon interaction relation for every parameter (tensor), where only fixed tensor parameters influence one to others and because of your mathematical relation express exclusively only equivalents.

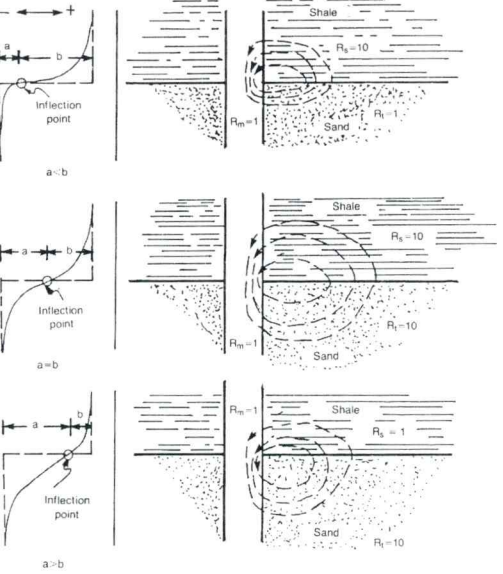


Fig. 5. Usual example of SP shape as a function of current distribution (after Helander, 1983).

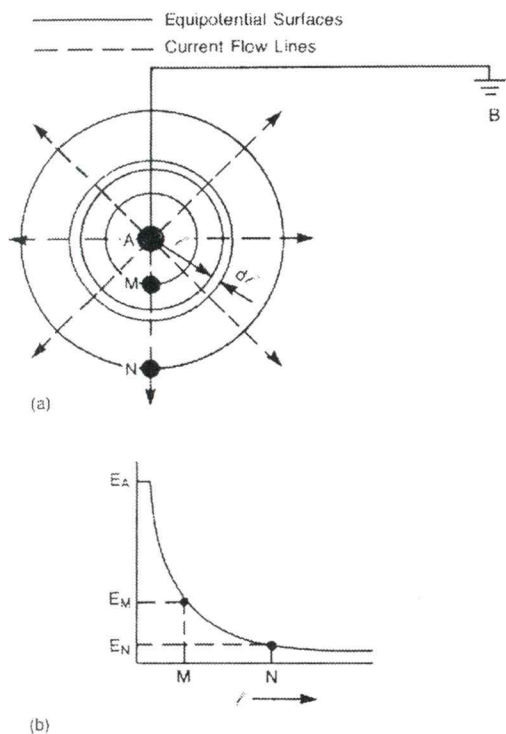


Figure 6. Idealized potential distribution for current flow in indefinite, homogenous, conducting medium (after Helander, 1983).

### Rock Formation Temperature ( $T_f$ )

Information quantum of rock formation temperature is visible and/or invisible dynamic value of stored space-time preon interaction relation. It is defined with place and accumulated energy in function of generating and changing proceeding rock condition. We are (first edited in this paper as authors' original idea) temperature quantum or cubic thermal stretching coefficient as thermodynamic preon interaction relation of four quantum fields within unified field at Lissajous spiral, there is interaction connection Riemann's spherical space discontinuum (first edited in this paper as authors' original idea)

$$\Rightarrow \alpha^{-1} = 2\pi^4 \times K^5 / K^{1/128} = 273,159787.$$

Electrons (first edited in this paper as authors' original idea) in entropy phase and enthalpy transition carry changing cubic thermal stretching coefficient as information quanta. However there are visible

or/and invisible phase equilibrium information of interference Hamiltonian transformation. It means, that entropy and enthalpy tensor transitions are in every inflection point at Lissajous projection ( $SP, R_t$  in  $R_i$ ), which is in transformation element function ( $R_m$ ) at the recording level of rock formation.

Measure mode of rock formation temperature after stabilized condition (information quantum of phase equilibrium temperature reversibility after cooling and relaxation) is very important for right access of defining hydraulic and geothermal field preon interaction relation for the time being temperature of environment function of new phase equilibrium. Then definition rock formation temperature must be recognized as exactly preon interaction relation of mathematical term relation for geothermal gradient on the bed level (A s q u i t h & G i b s o n, 1982), but also expressed (our suggestion) in absolute grade of temperature ( $^{\circ}K$ ). In the same time is very important for corrected interpretation, that every log running must measure all necessary parameters: surface temperature, bed level temperature and bottom hole temperature exclusively in absolute temperature. Why? Absolute temperature values ( $^{\circ}K$ ) are result of visual thermal of preon interaction relations in unified field, which means reality of Riemann's Universe. In that way real values deviation of bed level temperature doesn't show idealized condition, than real temperature of preon interaction relations within hydraulic and geothermal fields. Sorry, we can't use it completely, because exist only very different apparent data of measured surface temperature for Slovenia (from  $9^{\circ}C$  to  $12^{\circ}C$ ). So surface temperatures, what we have used for fixed well depend from our climate estimates.

$$T_g = \frac{BHT - ST}{TD} \quad (^{\circ}K/m)$$

$$T_f = T_g \times H_{fm} + S_t \quad (^{\circ}K)$$

BHT - bottom hole temperature

ST - surface temperature

TD - total depth

$T_g$  - temperature gradient

$H_{fm}$  - rock formation depth

ST - surface temperature



Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
H (m)	1161	1163	1673	1347	1533	2557	2815	1346	1137	2341	2576	1260
T (°K)	348	346	376	345	365	412	424	351	319	390	367	347

Spontaneous potential (SP)

In our opinion, what you only must do is simply read through SP-value (mV) from old electrical log without corrections. SP-value manifests visual reflections of preon interaction relation exactly fixed present phases: mud, mud filtrate, connate water, clayey or/and marly component, sandy or/and carbonate component, in electrochemical and electrokinetic potential equilibrium. Total electrochemical potential includes membrane potential preon interaction relation of connate water, dissolved clayey or/and marly component and mud or “liquid touch” (first edited in this paper as authors’ original idea) phase membrane potential of mud filtrate and connate water; ESSP. Electrokinetic potential is preon interaction relation of potential between liquid and solid phase; EPSP. The same it define Ohm’s law (preon interaction relation between current and potential) only for pure metals, but for relation with specific resistivity. What does it mean? It means (first edited in this paper as authors’ original idea) that every read through inflection point position (very close spacious part) is only usable as indicator of grade preon interaction relation of phases in phase equilibrium with activity coefficients of present components and phases (relations between different “ends”: ESSP ⇔ EPSP).

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
SP (mV)	33	43	110	75	66	22	3	6	10	115	10	68

Old mode of interpretation old electrical log uses SP-correction for bed thickness of clean sandy component from nomogram and correction factor from relation of  $R_i/R_m$ . In our opinion bed thickness and relation of  $R_i/R_m$  is recorded in SP-values. Problem is only in defining exactly preon interaction relation of all parameters, what they try to find.

Static Spontaneous Potential (SSP)

Drilling influence to primordial phase equilibrium changes because of phase and component diffusion mixture are going over to new really solutions, so that preon interaction induction once more influence to proceed from spiral electron motion between anion and cation as electrochemical potential projected on Lissajous graph (first edited in this paper as authors’ original idea). Then electrochemical potential beginning depends of closing electric current mode between all phases, components and electrodes on the interface as the shortest electron spiral way between ions. Otherwise differently you can recognize as preon interaction transition of connate water (contains fossil elements from beginning rock and dissolved rock particles; quite right information quantum), oil, gas, dissolved solid particles (marl or/and clay) and drilling mud. Static spontaneous potential proceeds from electromotive forces influenced with ion electrochemical reactions of connate water after mud filtrate (solution of connate water, mud and dissolved rock particles) at the “clayey or/and marly membrane” (fine grain sediment particles) interface for sandy or/and carbonate component manifestation in bed level temperature.

Next suggested authors’ original formula, where are parameters in maximal interference of spiral motion electrons and mathematical spiral transition of activation energy manifested only in natural logarithm of inflection points (spheres - “equipotential surface”; first edited in this paper as authors’ original idea):

$$ESSP = -K \times \ln(R_c / R_{mf}), \text{ (equivalent mV),}$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
SSP (mV)	33	43	110	75	66	22	3	6	10	115	10	67

Where are (first edited in this paper as authors’ original idea):

$$K = 63 + 0,0546 \times T \text{ (}^\circ K\text{)} - \text{temperature constant for electrochemical potential (mV; suggested authors’ original formula):}$$
$$63 = (n_x^2 - 1), \text{ where is } n_x \text{ regular number}$$



succession there is value 8 for Yukawa meson or pion ( $\mu\pi$ )  
 $0,0546 = 1 / (e^{2\pi} \times \alpha \times 4K_{jp}^2)$ ; suggested authors  
 'original formula):  
 $e$  - Euler's number ( 2,71875;  
 $\pi$  - Ludolf's number ( 3,140625;  
 $\alpha$  - Fine structure constant for  
 weak/strong interaction  
 $\Rightarrow (\alpha = 2\pi \times K_{jp}^2 = 7,32645 \times 10^{-3}$ ;  
 suggested authors 'original formula).

After our postulate (first edited in this paper as authors' original idea): "Exist preon connection in interference interactions between hadrons ( $2\pi/e$ ) and leptons ( $e/2\pi$ )."

we explain it, first in this paper, with electroweak/electromagnetic forces (Glashow-Weinberg-Salam theory), which interfere with strong interaction forces (pion,  $\mu\pi$ ). "Hadron is an elementary particle composed of quarks and/or antiquarks that can take part in strong interactions. Leptons are the class of elementary particles that do not take part in strong interaction. They have no substructure of quarks and are considered indivisible." (I l l i n g w o r t h, 1975).

$K_{jp}$  - unified field quantum coefficient  $\Rightarrow 1,08$   
 Unified field quantum coefficient (first edited in this paper as authors' original idea) is the basic spin of the unified field with its spiral entity. Value of  $K_{jp}$  they defined as preon interaction relations of every quantum field and its momentary "polarity" position  
 $\Rightarrow K_{jp} = (1! + 2!)^{(1! + 2!)} / (2! + (1! + 2!))^{2!} = 1,08$   
 (suggested authors 'original formula).

$T$  - temperature, °K

$\ln(R_c / R_{mf})$  - It is neper ( $N_p$ ) / redox potential of "input" - space-time element influence of facies (primordial phase equilibrium with  $R_c$ ) and "output" - change tensor (new phase equilibrium with  $R_{mf}$ ) in function of electric impedance stretching and contracting coefficient (Hamiltonian,  $H$ ). Then neper is preon interaction relation of electrochemical and electrokinetic energy expressed in mathematical term (first edited in this paper as authors' original idea).

## Pseudo-Static Spontaneous Potential (PSP)

Pseudo-static spontaneous potential is challenged with electromotive forces at "touch"-zone (contacts; first edited in this paper as authors' original idea) electrokinetic energy of rock cuttings and connate water and flushed zone (first edited in this paper as authors' original idea). Really it is streaming potential (inverse phenomenon of electroosmosis), which proceeded with creating potential differences after some fluid infiltration throughout porous rocks of marly or/and clayey component manifestation in bed temperature (suggested authors' original formula):

$$E_{PSP} = -K \times \ln(R_o / R_{xo}), \text{ (equivalent mV),}$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
PSP (mV)	14	22	71	46	31	8	0.7	2	2.5	72	2	38

Where is:

$\ln(R_o / R_{xo})$  - It is neper ( $N_p$ ) / redox potential of "input" - space-time element influence of facies water / rock (primordial phase equilibrium with  $R_o$ ) and "output" - change tensor of transition zone (new phase equilibrium with  $R_{xo}$ ) in function of electrical impedance stretching and contracting coefficient (first edited in this paper as authors' original idea).

## Sandy or Carbonate Component Volume ( $\alpha$ or $V_{sd}$ , $V_{car}$ )

Concept of sandy or carbonate component volume means, that it is recognized (A s q u i t h & G i b s o n, 1982 and P o u p o n et al., 1986) as exactly defined preon interaction relation for challenged electromotive forces after relation interference of sandy/carbonate compound component towards marly/clayey elemental component at "touch" potential "weak" and "strong" interactions (first edited in this paper as authors' original idea):

$\alpha = E_{PSP} / E_{SSP}$  (dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$\alpha$	0,43	0,51	0,65	0,62	0,48	0,35	0,25	0,30	0,25	0,62	0,19	0,57

Marly or Clayey Component Volume  
( $V_{sh}$ ,  $V_{cl}$ )

Concept of marly or clayey component volume means, that it is recognized (Asquith & Gibson, 1982 and Poupou, et al., 1986) as exactly defined preon interaction relation for challenged electro-motive forces after relation interference of bulk rock volume ( $2\pi/e$ ; “strong” and compound interaction; first edited in this paper as authors’ original idea) and sandy/carbonate component ( $e/2\pi$ ; “weak” and elemental interaction; first edited in this paper as authors’ original idea):

$V_{sh, cl} = 1 - \alpha$  (dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$V_{gr}$	0,57	0,49	0,35	0,38	0,52	0,65	0,75	0,70	0,75	0,38	0,81	0,43

True Rock Resistivity ( $R_t$ )

True rock resistivity (long normal - 64”) is already known manifested information quantum of motion velocity and sedimentation particle energy (facies, as lithology and fluids that fill porous space, with chronostratigraphy characteristics), which is changes throughout preon interaction relation depend of depth for every bed at diagram (Fig. 3.). That why, we simply directly read through value from resistivity log curve without correction:

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_t(\Omega m)$	23	17	24	28	66	24	22	9	19	70	50	20

Defining phase equilibrium with one phase or one component it is not in harmony with sedimentation system of genesis nature. First of all limitations what we have after old mode evaluation of true rock resistivity are mud conductivity, bed thick-

ness and borehole effect. However the only solution for these problems are in connecting with right parameters as preons, but now it is not so. Why it is very important? Rock nature is not homogeneous and bounded by parallel planes. Primordial phase equilibrium is relaxed and put out of order. New phase equilibrium behaves as strange body, what we receive are all information quantum of primordial phase equilibrium disregarding on deep measuring and flushed zone. It means, that read through  $R_t$  value shows elements of primordial and new phase equilibrium or momentary circumstance in borehole, which would be changed with chemical reactions all present components.

True Invaded Zone Rock Resistivity ( $R_i$ )

After drilling changed primordial phase equilibrium there is its directly reflection in already known manifested true invaded zone rock resistivity value (short normal - 16”) and therefore you only what to do is read through directly from resistivity log curve without correction.

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_i(\Omega m)$	24	22	60	59	39	22	20	9	15	68	32	22

Drilling Mud Resistivity on Bed Level  
( $R_m(t)$ )

Drilling mud resistivity on bed level measure with Mud log or arms collapsed Microlog sonde (ML), so that the measuring pad loses contact with the formation wall and “reads” the mud resistivity at down-hole conditions. Meanwhile, usually it is measured in the surface mud pool, when is log running and must be recorded in electrical log together with drilling mud temperature in this form:

$R_m / T, (\Omega m / ^\circ C)$ .

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_m(\Omega m)$	6	9	20	11	5,5	1,8	1,23	1,1	4,15	2,25	11	2,8
$T(^{\circ}C)$	20	35	18	24	22	17	17	17	15	24	19	16

More correct is to measure in the well bottom, because for log interpretation is more correct temperature data within well (close “in situ” temperature) then without one (far away “in situ” temperature). It is very important to know mud resistivity value, as present new phase and components in phase equilibrium, towards read through SP,  $R_t$  and  $R_i$  values, because you must separately to calculate it for every watched inflection point in Lissajous graph projection, as electron behaviour at spiral (suggested authors’ original formula):

$$R_{m(f)} = (R_m / e^{SP/K}) \times (\ln (T_f/T_{fl}) ),$$

(equivalent,  $\Omega m$ ),

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_{mf} (\Omega m)$	0.69	0.62	1.37	0.78	0.53	0.49	0.45	0.20	0.41	0.16	2.75	0.22

Where is (first edited in this paper as authors’ original idea):

- $R_{m(f)}$  - drilling mud resistivity in exactly fixed point (inflection point) on the bed level
- $R_m$  - measured drilling mud resistivity
- $e^{SP/K}$  - phase equilibrium constant as basic tensor helicity coefficient (principle of twisty or/and knotty spiral nature of Universe) of maximum interference motion reduction for electron excitement and temperature constant for every inflection point in graph (first edited in this paper as authors’ original idea).
- $\ln (T_f / T_{fl})$  - It is neper (Np) / redox potential of “input” - space-time element influence of rock temperature tensor (primordial phase equilibrium with  $T_f$ ) and “output” - change fluid temperature tensor (new phase equilibrium with drilling mud temperature,  $T_{fl}$ ) in function of electric impedance stretching and contracting coefficient (first edited in this paper as authors’ original idea).

This preon interaction relation between received helicity spontaneous potential values, measured drilling mud resistivity and

temperature is visible only in connection with others mathematical relations, which is presented in this paper. Namely also exist different preon interaction relations in others mathematical relation system, if you interpretive in different way sight, but the most important is insight access of defining preon interaction relation.

**Mud Filtrate Resistivity ( $R_{mf}$ )**

In infiltrated bed part (compound field group) is mud filtrate resistivity (elemental field group) recognized as invisible value in manifested preon interaction relation  $R_i$ ,  $R_t$ , SP in  $R_{m(f)}$  (suggested authors’ original formula):

$$R_{mf} = R_{m(f)} \times R_i / (R_t \times e^{SP/K}), \text{ (equivalent, } \Omega m \text{).}$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_{mf} (\Omega m)$	0.48	0.47	0.92	0.66	0.14	0.35	0.40	0.18	0.28	0.04	1.56	0.11

It means, there are electron motion confinement with lithological and chronostratigraphic rock characteristics throughout present component and phase transition in function of maximum possible reach invasion on bed temperature.

Old mode defined mud filtrate resistivity and drilling mud by nomogram or measured on the well site by the logging engineer (API mud filter press).

**Mud Cake Resistivity ( $R_{mc}$ )**

Mud cake resistivity is recognized as invisible value in manifested preon interaction relation for time electron transition throughout drilling mud on bed level, when it is defined as visible function of spontaneous potential and bed temperature tensor helicity (suggested authors’ original formula):

$$R_{mc} = 1,5 \times R_{m(f)} / e^{SP/K} \quad \text{(equivalent, } \Omega m \text{),}$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_{mc} (\Omega m)$	0.69	0.55	0.55	0.47	0.36	0.57	0.65	0.27	0.54	0.06	3.66	0.15



where is:

1,5 - quantum coefficient time of electron transition, when there is electron fixed 1 cm long spiral and helicity path, also preon interaction relation in break symmetry level for basic polarization relation in unified field, cosmological constant through three polarity break level ( $K^{3!}$ ; first edited in this paper as authors' original idea) or equivalent  $E(m_p)$  of proton mass.

Very important characteristic of mud cake is its consistency with very low permeability ( $10^{-5}$  millidarcies) and thickness (1/8 to 3/4 inch) there is in direct influence on redox potential in solid -solution relation throughout phase equilibrium constant against electron spiral/helicity; first edited in this paper as authors' original idea).

Old mode define mud cake resistivity by nomogram or measured on the well site by the logging engineer (API mud filter press).

Connate Water Resistivity ( $R_c$ )

We prefer notion connate water (innate and fossil pore water) to formation water, because it means generating through time no formation of reservoir rock (W y l l i e, 1986). In principle, we can tell that really exists true mixture of connate water, for result of preon interaction relation (solvent entropy) with two electrostatic interaction features: bound (irreducible) waters with bond of dissolved substances (water and fine grain platelets) and free water (hydrogen bond). Namely, water included in the groundwater (all the water below the water table) that is derived from the rock itself (information quantum) or water which is trapped in sediments when formed, as opposed to water which has percolated down from the surface. This explanation to base in our common nature low (first edited in this paper as authors' original idea): Every energy quantum has its cumulative, transparent and reflexive tensor quanta. There are stored in information quantum form for exactly defined preon time-space relation in spiral/helicity interference of electromagnetic, gravitational, weak and strong interaction fields within unified field, for example: changes of connate water charac-

teristics and seismic velocity in depend of chronostratigraphy, genetic cod, phylogenesis, tissue regeneration... Connate water resistivity ( $R_c$ ) value must be in harmony with syngenetic facies water characteristics in rock. It is defined with recognized invisible preon interaction relation of maximum bed invasion reach in function of reduction chronostratigraphic and facies parameters for read through spontaneous potential value at bed temperature or directly depend from phase equilibrium constant (suggested authors' original formula):

$$R_c = R_{mf} / e^{SP/K}, \qquad \text{(equivalent, } \Omega m)$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_c$ ( $\Omega m$ )	0,32	0,28	0,25	0,26	0,6	0,27	0,38	0,17	0,25	0,01	1,39	0,05

Into considerations salinity of connate water and drilling mud there are many interpretation and connection with reconstruction of SP-graph, which to base a pure NaCl solution, as mud filtrate ( $R_{mf}$ ) and  $Na^+$  (fresh water),  $Ca^{++}$  and  $Mg^{++}$  (high salinity water) activity by means of the charts (M. G o n d o u i n et al., 1957). It is correct, but we think first of all that key preon interaction relation for this depend from the same parameters through SP respectively phase equilibrium constant ( $e^{SP/K}$ ). What does it mean? It means only one that  $e^{SP/K}$  is membrane potential expressed in inflection point of SP-graph. Problem of classical mode of log interpretation is that natural NaCl brines can't be compare with  $Na^+$  concentration of drilling mud.

Old mode only defined formation water (more exactly free water) resistivity from nomograms (Fig. 7). Value resistively span for clean and natural water in Fig. 7 is very usable, but we suggest that it must be in natural logarithm (naperian).

Connate 100% Water Saturated Resistivity ( $R_o$ )

Why connate 100% water? We must define really reaction between components for better understanding what really happen in bed when drilling mud penetrates. When drilling mud invades, it tries to dis-

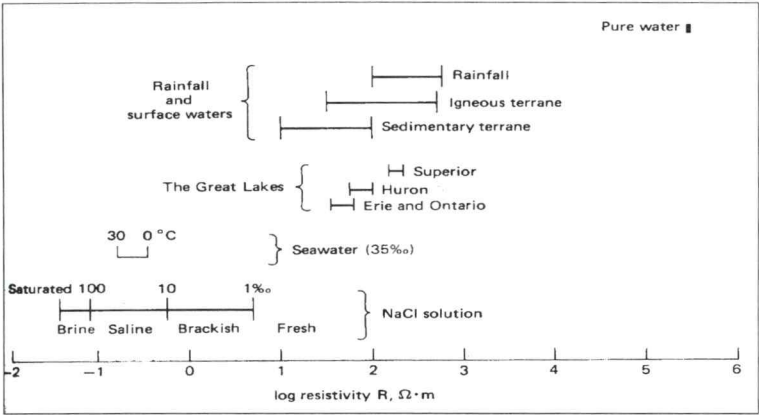


Figure 7: Value resistivity span for clean and natural water (after Hearst & Nelson, 1985)

place and drives out connate water. Some parts in invasion zone remain perfectly filled with bound (irreducible) water or bound and free water trapped in no connected pores. That trapped connate water has its resistivity (wet resistivity; Asquith & Gibson, 1982), what we call connate 100% water resistivity.

Connate 100% water saturated resistivity ( $R_o$ ) is visible value in approach link for true rock resistivity and wettability (suggested authors' original formula):

$$R_o = R_t \times R_c / (R_{mf} \times e^{SP/K}), \text{ (equivalent, } \Omega m).$$

Area	Ormož-Seinca antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_c (\Omega m)$	10.3	5.9	1.7	4.5	13.4	14.3	20.5	7.8	14.8	4.6	39.4	3.8

It is recognized in preon interaction relations of paragenetic and syngenetic tensor (first edited in this paper as authors' original idea) for relaxed solid component ( $R_t$ ) towards confinement relation (redox potential) of aggressive input ( $R_{mf}$ ) and increased output ( $R_c$ ) liquid components in new phase equilibrium.

Usually is  $R_o$  value derived from an Electrical Survey - Induction Log, but we have a lot of old electrical log with some others. In our  $R_o$  interpretation exist opposite proportionality between  $R_t$  and  $R_{mf}$ . We explain it with existing of bound water that 100% occupy fraction surface of pore space (dual-water model; Dewana, 1983).

Resistively Index ( $I_R$ )

Exist two key factors, wettability and saturation, influence on resistivity index by capillary pressure, confining stress, temperature and microporosity, as result of change equilibrium conditions. That's why resistivity index comes from preon interaction relation between primordial ( $R_c$ ) and new ( $R_{mf}$ ) phase equilibrium throughout redox potential interference ( $e^{SP/K}$ ). What does it mean? Be it so for all other interpretations for connection between resistivity index and wettability of the rock surface (Helander, 1983), rock texture (Helander, 1983), clay presence (Helander, 1983), measurement technique (Helander, 1983) and displacing fluid nature (Helander, 1983), but in different interaction relation (suggested authors' original formula):

$$I_R = R_{mf} \cdot e^{SP/K} / R_c, \quad \text{(dimensionless).}$$

Area	Ormož-Seinca antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$I_R$	2.2	2.9	13.9	6.2	4.9	1.7	1.1	1.2	1.3	15.3	1.3	5.3

Because resistivity index expresses the most important preon interaction relations in borehole and virgin rock, in correlation with string theory we try to define parameters for zone of hydrocarbon present and exploitation on base of obtained analyze data (suggested authors' original idea):



- 1 < I<sub>R</sub> < 1,1 - water level
- I<sub>R</sub> = 1,1 - water- hydrocarbon contact point
- 1,1 < I<sub>R</sub> < 3,5 - transition level
- 3,5 < I<sub>R</sub> < 7,5 - economical downgrade hydrocarbon level
- I<sub>R</sub> > 7,5 - economical upgrade hydrocarbon level

Where are (first edited in this paper as authors' original idea):

- 1 = e<sup>o</sup> - Zero inflection point, minimum interaction stage or rest state (Hamiltonian principle).
- 1,1 - Lower reference of inflection point for water and hydrocarbon lower contact point (ħ<sup>2</sup> - quantum coefficient square of Dirac's constant; the first interaction stage for the first symmetry break level in unified field).
- 3,5 - Middle reference of inflection point for water and hydrocarbon mixture (π × ħ<sup>2</sup> - the second interaction stage for the second symmetry break level in unified field).
- 7,5 - Upper reference of inflection point for water and hydrocarbon upper contact point (2K × π × ħ<sup>2</sup> - the third interaction stage for the third symmetry break level in unified field).

Hydrocarbon Resistivity (R<sub>h</sub>)

Hydrocarbon resistivity (H a l a b u r a, 1998) as term in this meaning is first used in this paper as authors' original idea. What will be aim or role this term? You know that exist terms in use for hydrocarbon reservoir evaluation: resistivity index (I<sub>R</sub>), hydrocarbon saturation (S<sub>h</sub>) and moveable oil saturation (MOS), but no hydrocarbon resistivity (R<sub>h</sub>). Our aim is to define as soon as more exact hydrocarbon data for reservoir evaluations into consideration of exploitation point of view. By this we defined hydrocarbon resistivity as visible preon interaction relation of resistivity index and true invaded zone rock resistivity in function of decreasing read through SP-values and bed level temperatures (suggested authors' original formula):

$$R_h = I_R \times R_i / e^{SP/K}, \quad (\text{equivalent, } \Omega m).$$

Area	Ormož-Selica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
R <sub>h</sub> (Ωm)	35,9	37,2	224	147	86,4	28,5	20,7	9,7	17	266	36	50,4

We think that R<sub>h</sub> is very important parameter for correct hydrocarbon reservoir evaluation, because in old electrical log there are three decisive parameters R<sub>i</sub>, SP and temperature, which define it. Namely, preon interaction relation between SP and R<sub>i</sub> show how much is phase equilibrium put out of order, what they see in hydrocarbon component (R<sub>h</sub>) changes. In the same time they think that R<sub>h</sub> has still one very important character for hydrocarbon evaluation possibility for defining type of hydrocarbon component (gas, condensate or oil). On the base of obtained analyze data we try to define parameters for zone of hydrocarbon present and exploitation (suggested authors' original idea):

- R<sub>h</sub> < 12,6 - water level
- R<sub>h</sub> = 12,6 - water- hydrocarbon contact point
- 12,6 < R<sub>h</sub> < 34,2 - transition level
- 34,2 < R<sub>h</sub> < 68,3 - economical downgrade hydrocarbon level
- R<sub>h</sub> > 68,3 - economical upgrade hydrocarbon level

Where are (first edited in this paper as authors' original idea):

- 12,6 - Lower reference of inflection point for water and hydrocarbon lower contact point (4π = μ<sub>0</sub> - the first interaction stage of polarity direction for the first symmetry break level in unified field).
- 34,2 - Middle reference of inflection point for water and hydrocarbon mixture (4π × e - the second interaction stage of polarity direction for the second symmetry break level in unified field).
- 68,3 - Upper reference of inflection point for water and hydrocarbon upper contact point (8π × e - the third interaction stage of polarity direction for the third symmetry break level in unified field).



Cementation exponent (m)

Generally cementation exponent is using as laboratory-measured value for formation resistivity factor evaluating. However problem is rock complexity and its dependence of very different factors: cementation degree (H e l a n d e r, 1983), shape, sorting and particulate system packing (H e l a n d e r, 1983), pore system type - intergranular, intercrystalline, vuggy, etc. (H e l a n d e r, 1983), pore system tortuosity (H e l a n d e r, 1983), constructions existing in porous system (H e l a n d e r, 1983), “conductive solids” presence (H e l a n d e r, 1983), compaction due to overburden pressure (H e l a n d e r, 1983), thermal expansion (H e l a n d e r, 1983) etc. That’s why, must be in our opinion use cementation exponent according to lithification and diagenesis cementation nature. Usually cementation exponent shows different rock types as a function of rock cementing degree, which values vary over a wide range from 1,3 to 2,8 (H e l a n d e r, 1983) or from 1 to 4 (B a l i ć, 1993). C o a t e s & D u m a n o i r, (1973) try to connect it with saturation exponent (n) with new parameter (m=n=w) that would be defines different rock classifications (class 1 to class 3). We approach to define range of cementation exponent (first edited in this paper as authors’ original idea) as preon interaction relation between all above said lithification-diagenesis parameters, which must be in direct dependence by “ $\pi - e$ ” influence every of four quantum fields (first edited in this paper as authors’ original idea). What does it mean? It means that cementation exponent in that method expresses rock type cementation bonds, consolidate degree of sediments and solidify (first edited in this paper as authors’ original idea):

- a) carbonates and solid rocks from 1,72 to 5,28
- b) clastics with carbonate cementation bond from 1,36 to 4,92
- c) clastics with clayey-marly cementation bond from 1,00 to 4,56 and
- d) clastics with clayey cementation bond and unconsolidated rocks from 0,00 to 3,56.

That rock classification with cementation exponent points to mutual interference

parameters with range overlapping, but also in direct pore system dependence, when tortuosity factor (a) is also exactly defined parameter (no constant).

Consequently cementation exponent with cementation bond type and rock cementation degree is recognized as preon interaction relation of drilling mud resistivity on bed level ( $R_m$ ) and connate water resistivity ( $R_c$ ) in function of present sandy, carbonate, marly and clayey component in porous space. It is with regard to point of preon view visible in excited sheaf contracting of wavy motion electrons throughout fixed bed (suggested authors’ original formula):

$$m = (R_{mf} / (\alpha \times R_c))^{1/e} \quad (\text{dimensionless}),$$

Area		Ormož-Selnica antiform (Petišovci field)						Fault-bounded traps and Filovci field					
Well		1	2	3	4	5	6	7	8	9	10	11	12
m		1,58	1,56	1,90	1,67	1,76	1,62	1,69	1,60	1,75	1,96	1,91	1,67

- Where are (first edited in this paper as authors’ original idea):
- $\alpha$  - sandy or/and carbonate component volume as fine grain platelets, which are possible matter base of solution for pore filling
  - $1/e$  - “sheaf contracting factor” of unified field, Hamiltonian principle (first edited in this paper as authors’ original idea).

Tortuosity factor (a)

Tortuosity factor as crookedness of the pore pattern is after that method recognized as invisible exponent of preon interaction relation of connate water resistivity in function of present sandy, carbonate, marly or clayey component and drilling mud resistivity with pore space and cementation degree. What we see it is its manifestation as visible preon interaction relation through excited spreading of sheaf wavy electron motion throughout fixed bed (suggested authors’ original formula):

$$a = e^{\alpha \times R_c/R_{mf}}, \quad (\text{dimensionless}),$$

Area		Ormož-Selnica antiform (Petišovci field)						Fault-bounded traps and Filovci field					
Well		1	2	3	4	5	6	7	8	9	10	11	12
a		1,34	1,35	1,19	1,28	1,24	1,31	1,27	1,32	1,25	1,17	1,19	1,28

Where is  $e^a$  grain framework degree (first edited in this paper as authors' original idea), which impact to whole rock constitution in spite of pore space.

You know there are three methods by tortuosity determination:

- a) computation from the formation and porosity value (H e l a n d e r, 1983),
- b) measurement by ionic transit-time studies (H e l a n d e r, 1983) and
- c) streaming (electrokinetic) potential (H e l a n d e r, 1983)

We (first edited in this paper as authors' original idea) think that rock texture and structure is base of tortuosity factor, that directly influence on the beginnings of complex meandering paths between pores and fine interconnecting capillaries in function of lithification-diagenesis parameters (anisotropy coefficient principle of primordial phase equilibrium; first edited in this paper as authors' original idea) and new phase equilibrium (E<sub>PSP</sub>). That's so, why we try to define it with Euler's number:

$$e^0 < a < e^1$$

After that we postulated (first edited in this paper as authors' original idea), on the collective excitations theory (plasmons and phonons in solids; after Bose-Einstein condensation), energy equipartition theory [ $3kT_t$  in function of frequency ( $\nu_0$ ) by absolute melting point after Lindemann, 1910 and  $3R$  in function of Planck-Einstein frequency ( $\nu_0$ ) by mole heat], theory of specific heat capacities [ $T_3$  law and  $3N_\sigma$  (k); after Debye, 1912], sound wave propagation in rock [proton motion as function of  $3\lambda_p = (2K)^4 \cong 21$ ; after Hegedušić, 1937; Heisenberg, 1938 and Fertl, 1976] and postulate of polarity interaction (gauge theory), that base of preon interaction relation for rock petrophysics is expressed throughout mathematical term (a + m; first edited in this paper as authors' original idea), which manifests as isotropy degree (principle Debye length):

$$e < \begin{matrix} (a+m) \\ \Downarrow \end{matrix} < 2! \times \pi$$

isotropy < (isotropy + anisotropy) < anisotropy

Where is (first edited in this paper as authors' original idea):

- (a + m) - rock constant (middle polarization/entropy-enthalpy stage) that is visible from your point of view
- $2! \times \Pi$ - maximum interaction polarization/entropy-enthalpy stage as one of inflection point (Hamiltonian)

If you express their mutual interaction as "m/a"-relation receives facies characteristics of rock: (suggested authors' original idea) there are:

- $m/a > 2,5$  - carbonate environment and solid rocks
- $2,5 < m/a < 2,0$  - transition carbonate environment and solid rocks
- $2,0 < m/a < 1,0$  - clastic environment with predominant carbonate cementation
- $1,0 < m/a < 0,5$  - clastic environment with predominant marly and clayey cementation
- $m/a < 0,5$  - clastic environment with clayey cementation and unconsolidated rocks.

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
m/a	1,18	1,16	1,6	1,3	1,42	1,24	1,33	1,21	1,4	1,67	1,61	1,3

Where mathematical relation (first edited in this paper as authors' original idea)  $2,5/0,5 = 5$  expresses base of preon interaction state of manifested unified field in rocks by collective excitation (plasma interaction of charged particles  $\Rightarrow 1+2^2$ ).

### Rock Porosity ( $\Phi$ )

Rock porosity define degree of sorting, packing, cementing, angularity and roundness of the grains, what we have expressed through recognized invisible preon interaction relation between sandy/carbonate component and clayey/marly one in function of bonding degree (suggested authors' original formula):



$$\Phi = \alpha / [(1 - \alpha) \times e^m] \quad (\text{dimensionless}),$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$\Phi$	0,16	0,22	0,28	0,31	0,16	0,11	0,06	0,09	0,06	0,23	0,04	0,24

Where is  $e^m$  bonding degree (first edited in this paper as authors' original idea).

Bonding degree is cementation ability degree (first edited in this paper as authors' original idea), that depends of phase equilibrium in momentary structure-texture state of fixed rock. You can see that connection between grains is exactly defined substance ( $\alpha$ ) as bond-cementing agent, not only quartz or calcite, because it is result from total geological agents (all present substances, primary and secondary porosity). After old log interpretation only limitation must be bound water (surface tension) and free water (trapped) in porous space (principle of extraction apparatus), but we defined that through  $\alpha$ -definition (principle of replace rock fluid with drilling mud filtrate). That's why in old log evaluation use porosity logs (sonic log, density log, neutron log and combination neutron-density log) for determination rock porosity by the basic log interpretation with well known equation  $S_w = c (R_w / R_t)^{1/2} / \Phi$

### Formation Resistivity Factor ( $F_R$ )

Notion formation resistivity factor expresses exactly defined rock structure and texture after Archie's law, but not only for clean sediments, than also for all others ones. If you use it after old kind of log interpretation, than it not be correct. It means that there are in use too idealized models against true rock formation conditions through generalized equations ( $F=1/\Phi^2$  or  $F=0,62/\Phi^{2,15}$  or  $F=0,81/\Phi^2$ ). That's why appeared problem of fluid independent in the pores what is defined with equation  $F= R_o / R_w$  that point out at importance to define exact equation for every evaluated point of fixed bed. We consider that general equation is exact defined recognized invisible preon interaction relation between texture and structure (a, m) and pore space in function of bed fluid saturation (Asquit & Gibson, 1982; Frank, 1986; Brock, 1986):

$$F_R = a / \Phi^m, \quad (\text{dimensionless})$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
F	24	15	14	9	33	49	142	67	180	20	675	14

As above-mentioned it is very important that for every point at log graph must be single evaluated with all parameters (a, m and ?), no so as after old kind of log interpretation where is the based on nomograms. That's why we prefer using standard formulas for formation resistivity factor of exactly fixed part of bed, which define interval interference (preon interaction relation) of facies rock type through cementation exponent and tortuosity factor (first edited in this paper as authors' original idea):

1. Carbonate environment and solid rocks (first edited in this paper as authors' original idea):

$$\begin{aligned} (e^1 - e^0) < m < (2\pi - e^0) &\Rightarrow a = e^0 = 1 \\ (1,72) < m < 5,28) &\Rightarrow F = e^0 / \Phi^m \Rightarrow F = 1 / \Phi^m \end{aligned}$$

It means that on condition  $a = 1$  pass for standard formula  $F = 1/\Phi^m$  only in boundary limit from  $F = 1/\Phi^{1,72}$  (suggested authors 'original formula) to maximum  $F = 1/\Phi^{5,28}$  (suggested authors 'original formula) respectively that pass for carbonate environment and solid rocks at fixed fissure systems at ( $e^0$ ; first edited in this paper as authors' original idea) and maximum possible recognized reach for that preon interactions or for high cementation grain degree ( $2\pi - e^0$ ; first edited in this paper as authors' original idea).

2. Clastic environment with carbonate cementation (first edited in this paper as authors' original idea):

$$\begin{aligned} (e^1 - e^{1/2!}) < m < (2\pi - e^{1/2!}) &\Rightarrow a = e^{1/2!} = 1,36 \\ 1,36 < m < 4,92 &\Rightarrow F = (e^{1/2!}) / \Phi^m \Rightarrow F = 1,36 / \Phi^m \end{aligned}$$

It means that on condition  $a = 1,36$  pass for standard formula  $F = 1,36 / \Phi^m$  only in boundary limit from  $F = 1,36 / \Phi^{1,36}$  (suggested authors 'original formula) to maximum  $F = 1,36 / \Phi^{4,92}$  (suggested authors 'original formula) respectively that pass for



clastic environment with carbonate cementation at fixed fissure systems at  $(e^1/2!)$ ; first edited in this paper as authors' original idea) and maximum possible recognized reach for that preon interactions or for high cementation grain degree  $(2\pi - e^1/2!)$ ; first edited in this paper as authors' original idea).

3. Clastic environment with clayey-marly cementation (first edited in this paper as authors' original idea):

$$[e^1 - (e^1 - e^0)] < m < [2\pi - (e^1 - e^0)] \Rightarrow a = e^1 - e^0 = 1,72$$

$$1,00 < m < 4,56$$

$$F = (e^1 - e^0) / \Phi^m \Rightarrow F = 1,72 / \Phi^m$$

It means that on condition  $a = 1,72$  pass for standard formula  $F = 1,72 / \Phi^m$  only in boundary limit from  $F = 1,00 / \Phi^{1,36}$  (suggested authors 'original formula) to maximum  $F = 1,36 / \Phi^{4,56}$  (suggested authors 'original formula) respectively that pass for clastic environment with carbonate cementation at fixed fissure systems at  $[(e^1 - e^0)]$ ; first edited in this paper as authors' original idea] and maximum possible recognized reach for that preon interactions or for high cementation grain degree  $[2\pi - (e^1 - e^0)]$ ; first edited in this paper as authors' original idea].

4. Clastic environment with clayey cementation and unsolidated rocks (first edited in this paper as authors' original idea):

$$(e^1 - e^1) < m < (2 - e^1) \Rightarrow a = e^1 = 2,72$$

$$0,00 < m < 3,56$$

$$F = e^1 / \Phi^m \Rightarrow F = 2,72 / \Phi^m$$

It means that on condition  $a = 2,72$  pass for standard formula  $F = 2,72 / \Phi^m$  only in boundary limit from  $F = 2,72 / \Phi^0$  (suggested authors 'original formula) to maximum  $F = 1,36 / \Phi^{3,56}$  (suggested authors 'original formula) respectively that pass for clastic environment with carbonate cementation at fixed fissure systems at  $[(e^1 - e^1)]$ ; first edited in this paper as authors' original idea] and maximum possible recognized reach for that preon interactions or for high cementation grain degree  $[(2\pi - e^1)]$ ; first edited in this paper as authors' original idea].

You can see that the base of rock types or environments depend from tortuosity factor, what above already before have been defined through following parameters:

“sheaf contracting factor” of unified field  $(1/e)$ , grain framework degree  $(e^a)$  and bonding degree  $(e^m)$ . In the other hand our recommendation is that before go to define petrophysical characteristics of rocks we must succeed following guides (first edited in this paper as authors' original idea):

1. To make no use of standard formula, but general equation for every bed point (inflection):  $F = a / \Phi^m$

2. To define facies bed characteristics:

- a) on the base of cementation exponent  $(m)$ ,
- b) on the base of preon interaction relation  $m/a$  and
- c) on the base of “porousness axion degree” (first edited in this paper as authors' original idea) for medium heterogeneity,  $BVW^a$ :

$BVW^a < 0,02 \Rightarrow$  secondary porousness for clastic environment (first edited in this paper as authors' original idea)

$BVW^a < 0,02 \Rightarrow$  primarily porousness for carbonate environment and solid rocks (first edited in this paper as authors' original idea).

Where is value of  $0,02 \Rightarrow (1/4K)^e$  for  $BVW^a$  in fact elementary point inflection of maximum possible preon interaction activity of all 4-quantum fields within unified field between secondary and primarily porousness (first edited in this paper as authors' original idea).

Exist many different accesses for determination lithology types especially with connection between formation resistivity factor and porosity, but we think that the base for it must be  $BVW$ .

### Shale Resistively ( $R_{sh}$ )

In our opinion is shale resistivity ( $R_{sh}$ ) very important parameter for correct evaluation well data from logs in hydrocarbon reservoir rock evaluation. So our meaning also confirm very different authors (shale factor and overpressure - F e r t l, 1976). That's why we decide to define that parameter (first edited in this paper as authors' original idea) as function of connate water against axion (helicity) influence of present components (electrochemical / electroki-

netic) spontaneous potential (suggested authors' original formula):

$$R_{sh} = [R_c \text{ (SSP-PSP)}] / \text{PSP} \quad (\Omega m)$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
R <sub>sh</sub> (Ωm)	0,42	0,27	0,13	0,16	0,07	0,50	1,15	0,40	0,75	0,01	5,74	0,04

### Apparent Connate Water Resistivity ( $R_{ca}$ )

Well known is the fact that with use "quick-look" logs ( $R_{wa}$ -log, porosity overlay, resistivity or F-overlay, SP or  $R_{xo}/R_t$  overlay and cyberlook log) can be shown directly hydrocarbon or/and water presence. We simply use already well known Pirson-equation, which we explain as recognized invisible preon interaction relation between facies and rock density:

$$R_{ca} = R_t / F, \quad (\Omega m)$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_{ca}(\Omega m)$	0,72	0,80	3,43	1,64	0,31	0,45	0,41	0,19	0,32	0,15	1,76	0,25

On the analysis basis of  $R_c/R_{ca}$  relation we try to define hydrocarbon presence zones or exploitation probability hydrocarbon zones (first edited in this paper as authors' original idea):

- $0,86 > R_c / R_{ca}$  - water level
- $0,86 = R_c / R_{ca}$  - water- hydrocarbon contact point
- $0,86 < R_c / R_{ca} < 0,27$  - transition level
- $0,27 < R_c / R_{ca} < 0,09$  - economical down-grade hydrocarbon level
- $R_c / R_{ca} < 0,09$  - economical upgrade hydrocarbon level

Where are (first edited in this paper as authors' original idea):

0,86 - Lower reference of inflection point for water and hydrocarbon lower contact point ( $e/\pi = 1eV/k$  -the first interaction stage of entropy).

0,27 - Middle reference of inflection point for water and hydrocarbon mixture ( $e/\pi^2 \Rightarrow \pi^2/e = 3,63$  as quantum circulation - the second interaction stage of entropy).

0,09 - Upper reference of inflection point for water and hydrocarbon upper contact point ( $e/\pi^3$  - the third interaction stage of entropy).

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_o/R_c$	0,45	0,35	0,07	0,16	0,21	0,60	0,93	0,87	0,78	0,07	0,79	0,19

### Saturation Exponent (n)

You know that methods for measuring the saturation exponent is very complicated and time-consuming, therefore first of all must be measured in the laboratory on representative core samples. Many authors try to solve that problem connecting with very different parameters (wettability of the rock surface, rock texture, clay presence, nature of displacing fluid and measurement techniques), which affect to value of saturation exponent. Well known value of  $n = 2$  for sandstones (H e l a n d e r, 1983) or  $n = m$  for slightly cemented/consolidated sandstones (B a l i ć, 1993) is too often use in log evaluation. It is in our opinion incorrect, for example because it "is only valid for water-wet cores in which water saturation,  $S_w$ , are in excess of 30%" (H e l a n d e r, 1983) or similar. In the other hand problem is also its magnitudes what have been reported after many authors from less than 2,0 to above 25 (H e l a n d e r, 1983). We define saturation exponent (first edited in this paper as authors' original idea) as recognized invisible preon interaction relation between connate 100% water saturated resistivity ( $R_o$ ) and true invaded zone rock resistivity ( $R_i$ ) in function of Euler's ( $e$ ) number (suggested authors' original formula):

$$n = e^{R_o/R_i} \quad (\text{dimensionless}),$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
n	1,53	1,31	1,03	1,08	1,41	1,92	2,79	2,37	2,69	1,07	3,43	1,19

Where is (first edited in this paper as authors' original idea):

$$(e^0 < n < e^\pi) \Rightarrow (1 < n < 23,14);$$



$e^0$  - minimum interaction degree or tranquillity point inflection (lower level; first edited in this paper as authors' original idea)

$e^\pi$  - maximum interaction degree or motion point inflection (higher level; first edited in this paper as authors' original idea)

We analyzed obtained  $n$ -values so that correlated with exploitation data. Analyses show that values are going through very narrow change saturation domain for fixed fluid in rocks. For maximum interference (first edited in this paper as authors' original idea) is magnitude of  $1/e^\pi = 0,043232365$ , what is in direct connection with quantum coefficient of Dirac's constant. It means those values about  $n = 2$  are too high and indicating to very high water saturation.

Relation between  $e^0$  and  $e^\pi$  defines true condition of fluid saturation in rock through all phase equilibrium (first edited in this paper as authors' original idea):

a)  $e^0$  - dry

b)  $e^\pi$  - 100 % water saturation of pore space,

where is no influence between porosity, cementation degree or something other, but it depend only fluid type presence. Connecting cementation exponent with saturation exponent in log evaluation after our method is not correct, because essential differences are in basic relations between  $R_o \Leftrightarrow R_c$  and  $R_i \Leftrightarrow R_{mf}$ .

### Water Saturation ( $S_w$ )

You know that the base for evaluation water saturation for clean formation is Archie water saturation equation  $S_w = c \times (R_o / R_t)^{1/n}$ , where  $c = 0,9$  for sands and 1,0 for carbonate and  $n = 2$ , but it is after our opinion incorrect. What does it mean? It means that constants have been used in this equation are too statistical defined and can be apply only in specific conditions. That is the main reason for many authors to try solved problems of value considerable variations in real rock conditions. We agree with general root of Archie equation (A s q u i t h & G i b s o n, 1982):

$$S_w = (R_o / R_t)^{1/n}, \quad (\text{dimensionless})$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$S_w$	0,59	0,45	0,08	0,19	0,32	0,76	0,98	0,94	0,91	0,08	0,93	0,25

expresses exact preon interaction relation only then when you use computed parameters ( $n$ ,  $m$  or  $a$ ) like in that method. In the same time we think that fundamental relationship between resistivity index and water saturation ( $I_R = S_w^{-n}$ ) no expresses true condition (phase equilibrium) in rocks, if you use  $n = 2$ . Only right way is use exact fixed parameters for every point on plots.

### Hydrocarbon Saturation ( $S_h$ )

Because hydrocarbon saturation is the most important parameter for log evaluation it must represents first of all rock ability to transmit hydrocarbons or critical (cut-off) saturation values. That is why well known volumetric quantity ( $S_h = 1 - S_w$ ) must be connected with all others rock characteristics. We defined it as invisible preon interaction relation of true rock resistivity and hydrocarbon resistivity in function of saturation exponent (suggested authors' original idea):

$$S_h = 1 - (R_t / R_h)^{1/n}, \quad (\text{dimensionless}).$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$S_h$	0,25	0,45	0,89	0,78	0,17	0,08	0,02	0,03	0,04	0,71	0,1	0,54

Here is also problem that critical saturation of old evaluation is in the range from 30% to 70%, what is only statistical access of real rock condition. We first of all try to connect hydrocarbon saturation with lithological parameters and irreducible (bound) water saturation to define as soon as real recoverable hydrocarbon conditions.

### Flushed Zone Saturation ( $S_{xo}$ )

There are many very different interpretations of flushed zone saturation ( $S_{xo}$ ), where are the basis interference between mud filtrate, residual hydrocarbons and bound wa-



ter over lithology (clay, shale, sand...). In fact is definition problem in fluid type of flushed zone saturation. Which fluid is deal with? Mud filtrate or water or residual hydrocarbons or maybe lithology? We think that in flushed zone there are all above-mentioned ones in mutual interference. Namely lithological characteristics define every fixed rock, so that presence fluids are determined bulk preon interaction relations. It means (first edited in this paper as authors' original idea) that saturation exponent depends of all present fluids in pore space of rocks, but in three weak forces di-rections for fixed water saturation (postulate of polarity interaction - gauge theory; suggested authors' original formula):

$$S_{x0} = S_w^{1/3n},$$

(dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$S_w$	0,89	0,82	0,44	0,59	0,77	0,95	1,00	0,99	0,99	0,45	0,99	0,68

Movable Hydrocarbon Indicator ( $S_w/S_{x0}$ )

Movable hydrocarbon indicator as empirical guidelines have been established for economic failure diagnose of hydrocarbon reservoirs (from 0,7 to 0,8; T i x i e r et al., 1963; from 0,6 to 0,8 for the Permian Basin of West Texas; H o r s t & C r e a g a r, 1974). Problem in these evaluations is a lot of limitation (hydrocarbon-bearing beds, water-bearing beds and clean formation, flushing or invasion depth).

On the analysis basis of  $S_w/S_{x0}$  relation (A s q u i t h & G i b s o n, 1982) we try to define hydrocarbon presence zones or exploitation probability hydrocarbon zones (first edited in this paper as authors' original idea):

- $S_w/S_{x0} > 0,93$  - water level
- $S_w/S_{x0} = 0,93$  - water- hydrocarbon contact point
- $0,93 < S_w/S_{x0} < 0,68$  - transition level
- $0,68 < S_w/S_{x0} < 0,34$  - economical downgrade hydrocarbon level
- $S_w/S_{x0} > 0,34$  - economical upgrade hydrocarbon level

Where are (first edited in this paper as authors' original idea):

- 0,93 - Lower reference of inflection point for water and hydrocarbon lower contact point ( $K \times e/\pi$  - the first interaction stage of reach).
- 0,68 - Middle reference of inflection point for water and hydrocarbon mixture ( $2K/\pi$  - the second interaction stage of reach).
- 0,34 - Upper reference of inflection point for water and hydrocarbon upper contact point ( $K/\pi$  - the third interaction stage of reach).

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$S_w/S_{x0}$	0,66	0,55	0,18	0,31	0,42	0,80	0,98	0,95	0,92	0,17	0,94	0,37

Irreducible Water Saturation ( $S_{wirr}$ )

If  $S_w$  expresses free water saturation, then  $S_{wirr}$  expresses bound water saturation. That is very important for understanding different methods for it's determine with permeability, porosity and free water saturation after different authors. It is a fact that the best way to obtain true value of irreducible water saturation is through core samples. In our opinion it is right equation:

$$S_{wirr} = (R_c / R_t)^{1/n},$$

(dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$S_{wirr}$	0,06	0,04	0,01	0,01	0,01	0,1	0,23	0,19	0,20	0,00	0,35	0,01

as invisible preon interaction relation of visible connate water resistivity and true rock resistivity values in function of recognized invisible saturation exponent (A s q u i t h & G i b s o n, 1982).

Flushed Zone Resistivity ( $R_{x0}$ )

We know that flushed zone resistivity ( $R_{x0}$  for region which is generally extends about 3 inches) can be measured directly with microlog (must be very close true values), but if you have no others logs that would be very bad for right log evaluation. In our opinion we can obtain true  $R_{x0}$  values after suggested our original equation:

$$R_{X0} = R_t \times R_{mf} \times (S_w/S_{X0})^n / (R_c \times e^{SP/K}),$$

(equivalent,  $\Omega m$ ).

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
$R_{sp}(\Omega m)$	12,2	7,8	4,0	7,9	19,6	15,7	20,7	7,9	15,3	10,7	40,3	6,1

We can define it as invisible preon interaction relation of true rock resistivity and drilling mud resistivity with saturation exponent and movable hydrocarbon indicator there are in function of connate water resistivity that reduction chronostratigraphic and facies characteristic in bad formation temperature.

**Bulk Volume Water (BVW)**

BVW (Asquith & Gibson, 1982) as “quick look” method for identifying producible water and hydrocarbons using wireline logs has limited in complex and inconsistent lithologies, because it required the generation of cross-plots of porosity and water saturation. Today we have preferable techniques (QLBVW), which use depth measure plots with calculated logs to quickly predict produce water formation, hydrocarbons, both, or neither.

We recognized that equation as invisible granulometric indicator of preon interaction relation for rock grain size (facies) and fluid saturation in pore space function (Asquith & Gibson, 1982):

$$BVW = S_w \times \Phi, \quad (\text{dimensionless})$$

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
BVW	0,094	0,097	0,021	0,057	0,051	0,082	0,060	0,081	0,053	0,018	0,034	0,061

As above-mentioned problem is how to define lithological environment and porousness that is reason exist a lot of different modes. In the case when you have only old electrical log can be too difficulty to solve it. We try to connect all attainable obtained log data with core analyses and master logs after BVW-granulometric table (Asquith & Gibson, 1982). We try to reinterpret already known BVW-granulometric table (first edited in this paper as authors’ original idea) after unified field theory through

$0,02 \Rightarrow (1/4K)^e$  as definition for inflection point of maximum possible preon interaction of all four quantum fields within unified field:

a) Primarily porousness for clastic environment for  $BVW^a > 0,020$ :

Grain size by Wentworth (mm)		BVW
Gravel		
Fine	4 - 2	< 0,015
Sand		
Very Coarse	2 - 1	0,015 - 0,020
Coarse	1,0 - 0,5	0,020 - 0,025
Middle	0,5 - 0,25	0,025 - 0,035
Fine	0,25 - 0,125	0,035 - 0,050
Very Fine	0,125 - 0,0625	0,050 - 0,070
Silt		
Coarse	0,0625 - 0,0313	0,070 - 0,090
Middle	0,0313 - 0,0156	0,090 - 0,120
Fine	0,0156 - 0,0039	0,120 - 0,160
Clay		
Clay	< 0,0039	> 0,160

b) Secondary porousness for carbonate environment and solid rocks  $BVW^a < 0,020$ :

Name	Porosness and fissures (mm)	BVW
Very vuggy solid rocks and very cavernous carbonates	> 2	< 0,015
Vuggy and intergranular solid rocks and carbonates	2 - 0,5	0,015 - 0,025
Intergranular solid rocks and carbonates	0,5 - 0,25	0,025 - 0,035
Solid rocks and carbonates	< 0,25	> 0,035

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
BVW <sup>a</sup>	0,042	0,043	0,010	0,025	0,025	0,038	0,028	0,036	0,026	0,009	0,018	0,028

When we compare bulk volume water with saturation exponent we confirm their mutual preon interaction relation after surface tension in function of adhesion - cohesion polarization stage (first edited in this paper as authors’ original idea):

$BVW^n < 0,005$  - water  
 $0,005 < BVW^n < 0,015$  - gas  
 $0,015 < BVW^n < 0,026$  - gas, dissolved in oil  
 $0,026 < BVW^n < 0,035$  - gas condensate and light oil  
 $0,035 < BVW^n < 0,050$  - light oil  
 $0,050 < BVW^n < 0,059$  - middle-heavy oil  
 $BVW^n > 0,059$  - heavy oil

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
BVW <sup>a</sup>	0,027	0,047	0,019	0,045	0,015	0,008	0,000	0,003	0,000	0,014	0,000	0,036

Where exist two stages of inflection points (first edited in this paper as authors’ original idea):

1. Lower adhesion stage of polarization:  
 $0,005$  - Lower reference of inflection point for preon interference relation of water



and gas contact point ( $K_{jp}^{1/2} / K^{32} \times e^\pi$  - the first negative interaction stage of surface tension).

0,015 - Middle reference of inflection point for preon interference relation of dry and wet gas contact point ( $K_{jp}^{1/2} / K^{16} \times e^\pi$  - the second negative interaction stage of surface tension).

0,026 - Upper reference of inflection point for preon interference relation of wet gas, gas condensate and light oil contact point ( $K_{jp}^{1/2} / K^8 \times e^\pi$  - the third negative interaction stage of surface tension).

2. Upper cohesion stage of polarization:

0,035 - Lower reference of inflection point for preon interference relation of gas condensate and light oil contact point ( $K_{jp} / e^\pi$  - the first positive interaction stage of surface tension).

0,050 - Middle reference of inflection point for preon interference relation of light oil and middle heavy oil contact point ( $K_{jp}^2 / e^\pi$  - the second positive interaction stage of surface tension).

0,059 - Upper reference of inflection point for preon interference relation of middle heavy oil and heavy oil contact point ( $K_{jp}^4 / e^\pi$  - the third positive interaction stage of surface tension).

**Movable Oil Saturation (MOS)**

You know that movable oil saturation concept as “quick look” method is based on the water saturation existing in flushed zone, what need first of all correct  $R_{xo}$  values and other “ideal” conditions for right evaluation movable oil saturation. That is why in authors’ opinion very important to use exact values of all parameters for right log evaluation and well known *A s q u i t h & G i b s o n* equation:

$MOS = (S_{xo} - S_w)$  (dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
MOS	0.30	0.37	0.36	0.41	0.44	0.19	0.02	0.05	0.08	0.37	0.06	0.43

is acceptable for our mode of log evaluation. Then movable oil saturation is invisible preon interaction relation of connate

water saturation and flushed zone saturation for recognized visible value of movable hydrocarbon indicator.

**Residual Oil Saturation (ROS)**

Residual oil saturation ( $ROS \equiv S_{or}$ ) is that oil in the invaded zone, which can not be pushed by mud filtrate and remain in pore spaces (*A s q u i t h & G i b s o n*; 1982). In many cases is ROS-problem assumed or used by simple pulsed-neutron measurement or Log-Inject-Log technique, but hardly ever its value is questionable. The most important fact is that residual oil saturation is affected by mineral composition, clay matrix and cementing material, what we try to define by  $S_{xo}$ -definition. That's why our definition agree with well known equation:

$ROS = (1 - S_{xo})$  (dimensionless)

Area	Ormož-Selnica antiform (Petišovci field)							Fault-bounded traps and Filovci field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
ROS	0.11	0.18	0.56	0.41	0.23	0.05	0.00	0.01	0.01	0.55	0.01	0.43

that residual oil saturation is invisible preon interaction relation of bulk saturation and connate water saturation in invasion zone and is recognized as visible value of hydrocarbon tranquillity index.

**Bulk Fluid Permeability ( $k_{fl}$ )**

Permeability is reservoir ability to permit that reservoir fluid flow or passage, but its determination is very complex. Namely, every fluid has its permeability, which depends of other present components in phase equilibrium and rock type (for example: relation between porousness and permeability in clastics or carbonates). That's why are in use charts for determination permeability index of different fluids (for example: medium gravity oils or dry gas). We think that can be define every fluid permeability so we try to define for bulk fluid permeability (suggested authors’ original formula):



$$k_{fl} = \gamma_{fl} \times \Phi^n \times R_{mc}^m \times R_{mf}^{(a-1)} / R_c^2,$$

(equivalent mD).

Area	Ormot-Selnica antiform (Petišovci field)							Fault-bounded traps and Fiovoči field				
Well	1	2	3	4	5	6	7	8	9	10	11	12
k (mD)	3,76	3,58	3,81	3,16	20,37	3,51	1,72	1,73	2,55	25,86	3,49	7,8

As above-mentioned bulk fluid permeability is true rock permeability. We define it as recognized invisible preon interaction relation of bulk fluid gravity, when porosity tend to increase as total saturation function, when mud cake resistivity tend to increase as cementation exponent function, when mud filtrate resistivity tend to increase as fissure system function and when connate water resistivity tend to decrease.

Results and Discussion

Because in Nafta Lendava mainly exist unused old electrical logs with very poor data, authors have been forced to find new and different access in interpretation of old electrical logs. So this paper try to review this method into consideration with connecting unified field theory and geological practice. On account of above-mentioned and confirmations authors has been used old electrical log for petrophysical interpretation with applying this method on 153 well samples, which are very different in geology, geotectonics, lithology, fluid presence and production. In the next examples (Tables 1A, 1B, 2A and 2B) for using old

Table 1A: Comparison of proposal log interpretation with laboratory core test results for Mura valley wells.

Well	Depth (m)	Cementation exponent (m)		Tortuosity factor (a)	Formation resistivity factor (F <sub>R</sub> )		Rock porosity (Φ), %			Permeability (k), mD		
		Cores	Log		Cores	Log	Cores	Φ <sub>N</sub>	Log	Cores	Log	
1	1161	No data	1,58	1,34	No data	24	No data	No data	17	No data	3,76	
2	1163		1,56	1,35		15			21		3,58	
3	1673		1,90	1,19		14			27		3,81	
4	1347		1,67	1,28		9			30		3,16	
5	1533	1,7 - 2,0	1,76	1,24	21,41-40,26	33	15,6-22	9	15	1,2 - 24,9	20,37	
6	2557	No data	1,62	1,31	No data	49	7,5-11,9		10	0,11-1,6	3,51	
7	2815		1,69	1,27	47,13-111,82	142	4,1-8,7		9,5	3	0,08-0,17	1,72
8	1346		1,60	1,32	No data	67	9,8-17,9		35	5	0,52-11	1,73
9	1137		1,75	1,25		18	20,4-27,3		35	5	0,1-1,21	2,55
10	2341		1,96	1,17		2	4,6 - 20	No data	18	impermeab.-15	25,86	
11	2576		1,91	1,19		675	No data		3	No data	3,49	
12	1260		1,67	1,28		14			21		7,80	

Table 1B: Comparison of proposal log interpretation with laboratory core test results for Mura valley wells.

Well	Depth (m)	BVW	BVW <sup>a</sup>	m/a	Core and master log description
1	1161	0,094	0,042	1,18	No data
2	1163	0,097	0,043	1,16	
3	1673	0,021	0,010	1,60	
4	1347	0,057	0,026	1,30	
5	1533	0,051	0,025	1,42	Moderately cemented sandstone - mica sediment
6	2557	0,082	0,038	1,24	Fine grain sandstone - lime siltstone - 10 % CaCO <sub>3</sub> (master log)
7	2815	0,060	0,028	1,33	Fine grain sandstone - lime siltstone - 10 % CaCO <sub>3</sub> (master log)
8	1346	0,081	0,036	1,21	Middle hard, compact fine grain pelithic sediments; matrix - organic substance; present naphthenes (terrestrial in marine environment); 18% CaCO <sub>3</sub> - master log; TOC = 0,58%, R <sub>o</sub> = 0,35 %
9	1137	0,053	0,025	1,40	Middle hard clayey marl, highly carbonized coal; 49,6 % CaCO <sub>3</sub> - master log; clayey-calcite matrix; TOC = 32,44 %
10	2341	0,018	0,009	1,68	No data
11	2576	0,034	0,018	1,61	
12	1260	0,061	0,028	1,30	Fine grain sandstone (master log)

Table 2A: Comparison of proposal log interpretation with production data for Mura valley wells.

Well	Depth (m)	$I_R$	$S_w/S_{xo}$	$R_o/R_{ca}$	Interpretation
1	1161	2,2	0,66	0,447	transition level
2	1163	2,9	0,55	0,350	transition level
3	1673	13,9	0,18	0,072	economical upgrade hydrocarbon level
4	1347	6,2	0,31	0,162	economical downgrade hydrocarbon level
5	1533	4,9	0,42	0,204	economical downgrade hydrocarbon level
6	2557	1,7	0,80	0,598	transition level
7	2815	1,1	0,98	0,933	water level
8	1346	1,2	0,95	0,864	transition level
9	1137	1,3	0,92	0,780	transition level
10	2341	15,3	0,17	0,065	economical upgrade hydrocarbon level
11	2576	1,3	0,94	0,788	transition level
12	1260	5,3	0,37	0,190	economical downgrade hydrocarbon level

Table 2B: Comparison of proposal log interpretation with production data for Mura valley wells.

Well	BWW <sup>n</sup>	Interpretation	Hydrocarbon, %	Water, %	Fluid	Commentary
1	0,027	gas condensate and light oil	37	63	oil	producing horizon
2	0,047	middle heavy oil	54	46	oil	producing horizon
3	0,019	gas, dissolved in oil	70	30	oil	producing horizon
4	0,045	light oil	58	42	oil	producing horizon
5	0,014	gas, dissolved in oil			gas	producing horizon
6	0,008	water with gas				undeveloped
7	0,000	water				undeveloped
8	0,003	water				undeveloped
9	0,000	water				undeveloped
10	0,014	gas			gas	production test
11	0,000	water			gas traces	drill-stem test (DST)
12	0,028	gas condensate and light oil			gas /oil	tested horizon

electrical log interpretation and evaluation after proposal our method is showed 12 inflection points from Pontian to Badenian for different parts of Mura Valley wells in Pannonian Basin of Slovenia.

In brief, we can tell that base of this method is to establish real phase equilibrium as visible and/or invisible preon interaction relation of parameters and components through permanent phase equilibrium changes. Finally result is after that there are no limitations in method use. Consequently we assert that phase equilibrium is, in preon interaction relation with-in and with-out of one itself, what means that it is connect with kind of final relations that continue to infiniteness.

In the Table 1A and Table 1B we compare petrophysical rock parameters, which we are obtained from laboratory analyses and from others logging, which we inter-

preted with proposed our method. So we believe that we give a satisfactory account of application this method for interpretation of old electrical logs. In fact exist unreal statistic access (larger processing domain) towards preon relation interpretation (laboratory analyses) and real access (tighter processing domain) towards inflection point interpretation for exactly fixed place with proposed our method.

Comparative Tables 2A and Table 2B indicate to probable presence fixed fluid into harmony with preon interaction relations, which are in uniting with obtained production indicators and our commentary.

## Conclusions

It is evident that method indicates to total different or alternative access of old



electrical log interpretation and evaluation to point out direct connecting theory and practice, no depend domain go from. Basic aim is how define visible and invisible preon interaction relations, recognize, and mutual connecting them with each other.

What are unchangeable parts of beds, which are recovered with drilling? That part of bed, which has not been in contact with drilling mud, has not been relaxed or penetrated with regard to "in situ - conditions", respectively upon virgin rock. Where is see it? It sees by true rock resistivity ( $R_t$ ). Why? Because long normal grip only approximate preon interaction relation quantum coefficient of Compton electron wavelength with regard to excited electrons in maximum possible reach. In the same way can be define true invaded zone rock resistivity ( $R_i$ ), what indicates to quantum coefficient of Rydberg frequency because of preon interaction between primordial and new phase equilibrium.

In this paper mathematical forms are still partly review for reality, recognized visible and invisible preon interaction relations and there is no intention to accept mathematical lawfulness, but partly preon interaction conditions.

Base of our access and evaluation/interpretation of old electrical log is directly reading of values from logs and to use them in proposed formulas.

We have noticed those results would be the nearest to real layer conditions if one use following:

1. Exact data for layer temperature (measured on the bottom hole after well stabilization and
2.  $SP$ ,  $R_t$  and  $R_i$  without corrections.

Still one very important direction in interpretation old and also new log is defining individual parameter so that satisfies their mutual relations. It means that every changes and influences in their relationship can cause new changes and possible mistakes in your interpretation.

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