(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 819 086 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.12.2014 Bulletin 2015/01

(51) Int Cl.:
G06Q 50/02 *(2012.01)*

(21) Application number: **13382254.4**

(22) Date of filing: **28.06.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) **Method to generate scenarios of hydrocarbon reservoirs based on limited amount of information on a target hydrocarbon reservoir**

(57) The present invention is related to generating scenarios of hydrocarbon reservoirs based on limited amount of information on a target hydrocarbon reservoir, and more particularly to automatically supplying missing parameters and an uncertainty associated with each supplied parameter allowing to valuating the target hydrocarbon reservoir.

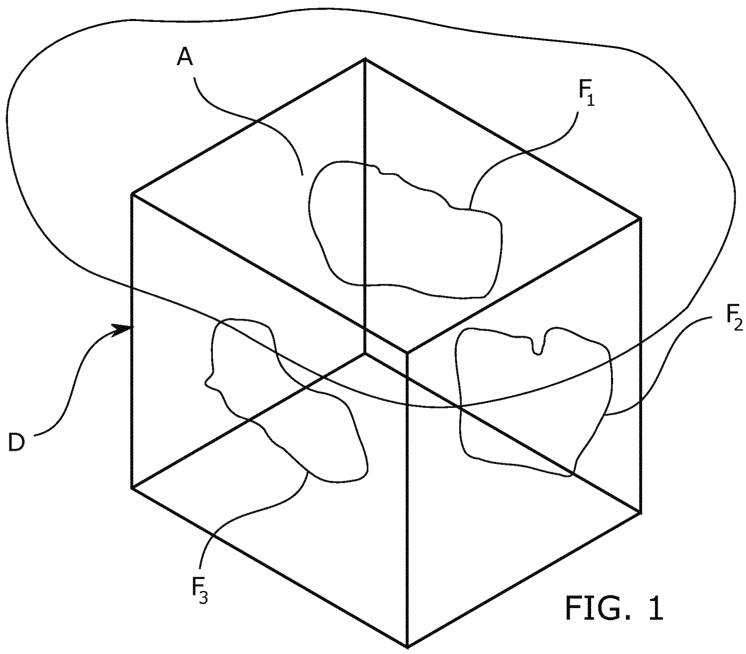

FIG. 1

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Description

OBJECT OF THE INVENTION

[0001] The present invention is related to generating scenarios of hydrocarbon reservoirs based on limited amount of information on a target hydrocarbon reservoir, and more particularly to automatically supplying missing parameters and an uncertainty associated with each supplied parameter allowing to valuating the target hydrocarbon reservoir.

PRIOR ART

[0002] Determining whether investing in a new hydrocarbon reservoir candidate is a good business decision depends on the inherent value of the reservoir. Factors determining the inherent value of the reservoir include, for example, the total amount of material that is ultimately recoverable from each new hydrocarbon reservoir (production potential), market prices (oil and/or natural gas prices) and the cost of recovering that material, or capture difficulty. Until the material is actually recovered, however, that inherent value can only be estimated from different, primarily known, reservoir properties.

[0003] However, investment opportunities frequently include a number of candidate reservoirs with spotty available information on each. Even with a dearth of available information, however, it is imperative to assess the value of each candidate accurately. This assessment may be even more complex when types of available information vary from candidate to candidate. Arriving at an optimal project portfolio value requires a uniform assessment that consistently evaluates all alternatives uniformly.

[0004] Some investment candidate estimates have been based on identifying existing reservoirs with properties that match or closely match (i.e., are similar to) the new, candidate reservoir. The closest existing reservoirs are known as "analogous reservoirs."

[0005] Typically, one or more experts (e.g., geologists and reservoir engineers) identified and selected analogous reservoirs, based solely on experience and known or available investment candidate properties. Relevant information of such analogous reservoirs are stored in data bases having records with information on volumetric, facies and properties distribution, wherein all records not necessarily have all properties.

[0006] The specialized literature shows continuously increased interest in analogues and its predictions. Sophisticated data mining and machine learning algorithms allow estimation of properties and such estimations also define the degree of uncertainty which can be reliably used within geostatistical workflows. Example can be found on the usage of reservoir analogous in the context of reservoir drive mechanism, recovery factor or reserve estimation and classification.

[0007] Insufficient information, however, can make selecting analogous reservoirs guesswork at best, and make estimating the value error prone and uncertain. A mis-valuation could lead to wasted resources, e.g., from passing on an undervalued reservoir to exploit an overvalued reservoir. Missing parameters increase uncertainty and the likelihood of a mis-valuation.

[0008] Thus, there is a need for generating scenarios compatible with the limited amount of information available on a target hydrocarbon reservoir, while including an associated uncertainty for the assessment; and more particularly, for estimating geological and petrophysical properties.

SUMARY OF THE INVENTION

[0009] The present invention solves the problems providing a method to generate scenarios of hydrocarbon reservoirs when only limited amount of information on a target is available. Ranking reservoirs with different level of associated uncertainty within the same framework becomes key to make robust and unbiased decisions. The method according to the present invention allows assessing not only the geological parameters not known a priory with their associated uncertainty but also the geological and structural uncertainty of the reservoir with an accurate propagation of the inherent uncertainty.

[0010] Normally, geological information comes from well logs, cores analysis, seismic data, etc. and production data can also be used to mitigate the uncertainty however in absence of these the geological scenario becomes hard to predict.

[0011] In most of cases, geological information comprises scalar values lacking of spatial distributions as a three-dimensional structure. The method according to present invention generates scenarios of hydrocarbon reservoirs having a three-dimensional structure even if departing from scalar values.

[0012] According to a first aspect of the invention, the method to generate scenarios of hydrocarbon reservoirs compiles information on the target hydrocarbon reservoir. Such information provides a *concept model* for the whole domain of the scenario. This information comprises scalar properties and may also comprise uncertainty data such as minimum and maximum values of some scalar data.

[0013] The method requires the proposal of an integer number n of facies. For each facie, the method provides automatically the partial rate f_i, and a normal distribution of the porosity having a mean value $\overline{\phi}_i$ and the cutoff values ϕ_i^{min} and ϕ_i^{max} for a predetermined threshold such that the area of the tail of the normal distribution is deemed to be neglectible beyond such threshold. Such variables are provided by solving an optimization problem that distributes the normal distribution of each facies in such a way the concept model is reproduced. The concept model is characterized by the number of facies *and* ϕ_{ref}^{min}, ϕ_{ref}^{max}, and the $\overline{\phi}_{ref}$ values of porosity of the target hydrocarbon reservoir.

[0014] The method mainly uses the computed partial rate f_i to populate a plurality of three-dimensional scenarios having a three-dimensional domain and the shape of the n facies by means of a multipoint statistical method, preferably and not limited to a Sequential Indicator Simulation.

[0015] Once the plurality of three-dimensional scenarios with the n facies are generated, each facie with its partial rate f_i and the normal distribution of the porosity defined by the mean value $\overline{\phi}_i$ and the cutoff values ϕ_i^{min} and ϕ_i^{max}, further embodiments of the invention allow to populate the spatial distribution of the permeability, the saturation and the net-to-gross variables.

DESCRIPTION OF THE DRAWINGS

[0016] These and other features and advantages of the invention will be seen more clearly from the following detailed description of a preferred embodiment provided only by way of illustrative and non-limiting example in reference to the attached drawings.

Figure 1 This figure shows a domain having three facies located within the do-main.

Figure 2 This figure shows a schematic representation of an analogous data base wherein selected records have been selected when comparing the in-formation of the target according to a predefined criterion.

Figure 3 This figure shows the distribution of the porosity for the concept model and how the normal distribution for each facies is distributed reproducing the concept model by solving an optimization problem.

Figure 4 This figure shows the set of scenarios generated in each property calculation providing a first generation and a second generation of scenarios.

DETAILLED DESCRIPTION OF THE INVENTION

[0017] The first step of the method according to an embodiment of the invention compiles information on the target hydrocarbon. This information may be interpreted by a skilled person who may provide the number n of facies from this collected information. The number of facies is preferably between 1 and 8. Figure 1 shows a field having a domain (D) under certain portion of its surface, the area identified with letter A. This figure shows a domain (D) having three facies F_1, F_2 F_3 distributed within the domain.

[0018] In absence of any information from seismic or maps the reservoir domain (D) is considered as a hexahedral shape. Structural uncertainty is considered on both shape and volume. In the present case since the conceptual model is a regular shape the uncertainty is represented by the reservoir area and thickness and the width-over-length ratio.

[0019] An interpolative function has been developed to estimate the joint distribution of reservoir area and thickness from the analogues data base whereas the width-over-length ratio parameter is assumed to be uniformly varying between its boundaries. Numerical analysis has shown that the reservoir area and thickness could be approximated with a lognormal bivariate distribution with a high confidence interval.

[0020] It is important to underline that the joint probability of area and thickness its key in order to preserve the interval of confidence given from the analogues in terms of volumetric and reserves. If there is information about the total amount of the oil of the reservoir or such amount may be estimated then the domain must be chosen big enough to contain that amount of oil.

[0021] According to an embodiment of the invention the number of facies and other properties may be obtained comparing the target information with the analog data base.

[0022] Each facies $F_i, i = 1..n$, is modeled by its partial rate f_i, and a normal distribution of the porosity having a mean value $\overline{\phi}_i$ and the cutoff values ϕ_i^{min} and ϕ_i^{max} for a predetermined threshold such that the area of the tail of the normal distribution is deemed to be neglectible beyond such threshold. Once the threshold is predetermined, the normal distribution is taken to be limited between ϕ_i^{min} and ϕ_i^{max} and the mean value satisfies $\bar{\phi}_i = (\phi_i^{max} - \phi_i^{min})/2.$ The partial rate f_i satisfies that $\sum_{i=1}^{n} f_i = 1$ being n the number of facies already fixed.

[0023] As is shown in figure 3, the whole domain is modeled by a ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\bar{\phi}_{ref}$ values which may be provided by a skilled person or the estimation may be obtained from the analogues data base, or more briefly "the analogues".

[0024] Next step calculates $f_i,\ \bar{\phi}_i, \phi_i^{max}, \phi_i^{min},\ i = 1..n$ as the solution of a minimization problem wherein the cost function is defined by the expression

$$Min\left(\| \phi_{left}^{min} - \phi_{ref}^{min} \| + \left\| \bar{\phi}_{ref} - \sum_{i=1}^{n} f_i \bar{\phi}_i \right\| + \| \phi_{right}^{max} - \phi_{ref}^{max} \| \right)$$

wherein ϕ_{left}^{min} and ϕ_{right}^{max} is defined by the condition

$$\phi_{left}^{min} = Min(\phi_i^{min});\ i = 1, \ldots, n$$

$$\phi_{right}^{max} = Max(\phi_i^{max});\ i = 1, \ldots, n$$

and $\bar{\phi}_i$ are taken such that $\bar{\phi}_i < \bar{\phi}_{i+1}$ $i = 1..n - 1$.

[0025] In an embodiment, the norm ||·|| has been implemented as the Euclidean norm. The objective function to be minimized represents the error between the estimated property as a function of facies type and the value provided for instance by the analogues.

[0026] Figure 3 shows a four facies case (n = 4) wherein the four normal distributions of porosity are distributed according to the minimum of the cost function; and, the partial rate f_i, $i = 1,...,4$ is simultaneously determined.

[0027] This minimization problem may be solved using Mixed Integer Linear Programming (MILP). The solution jointly computes the relative proportion of each facies and the conditional distribution of the properties per facies. This estimates will be consistent with the value of min, max and average used as the reference: ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\bar{\phi}_{ref}$.

[0028] In an embodiment of the invention the reference values ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\bar{\phi}_{ref}$ are obtained from the analogues data base (2). When compiling information on the target (1) hydrocarbon reservoir, said information at least have a material property among the material properties comprised in the records of the analog data base. The reference values are determined as follows:

1. When providing an analogues data base (2) comprising records of known reservoirs, at least one record further comprises the porosity of the material, that is, the minimum value ϕ_{an}^{min} of the porosity, the mean value $\bar{\phi}_{an}$ of the porosity, and the maximum value ϕ_{an}^{max} of the porosity.
These three values allow assuming a property distribution shape such as a Normal distribution. The porosity will be used to compute the reference value as the mean value of a subset of records of the analogs data having such property.
2. When compiling information on the target hydrocarbon reservoir in step a), such information has at least a material property among the material properties comprised in the records of the analog data base.
Common properties in the target hydrocarbon reservoir and in the analogs data base allows comparing the target (1) information and closely related analogues records (2.1). Common properties may be different to the porosity.
3. Provide a similarity criterion for the comparison of reservoirs sharing at least a common material property.

The similarity criterion is the criteria to define which records of the analogues data base are close to the target (1). This criterion may even combine properties or correlation between two or more properties.

4. Select the set of m records (2.1) in the analogues data base (2) meeting the similarity criterion with the target reservoir, wherein at least one record of the selected record comprises the porosity of the material,

5. Determining ϕ_{ref}^{min}, ϕ_{ref}^{max}, and the $\overline{\phi}_{ref}$ values wherein said values are obtained for the set of records of the analog data base selected in step 4) as:

- $\phi_{ref}^{min} = Mean(\phi_{an,j}^{min})\ j = 1 \ldots m$
- $\overline{\phi}_{ref} = Mean(\overline{\phi}_{an,j})j = 1 \ldots m$; and,
- $\phi_{ref}^{max} = Mean(\phi_{an,j}^{max})\ j = 1 \ldots m,$ for all records having the porosity information.

[0029] In an embodiment of the present invention, the plurality of three-dimensional scenarios having a three-dimensional domain is obtained generating the dimensions of said domain randomly. If the analogues has volumetric data such as the reservoir area and thickness, NTG (net-to-gross) and saturation information, then the maximum capacity to store oil within the domain is calculated. If the randomly generated domain (D) is not big enough to store the calculated volume of oil then said domain (D) is discarded.

[0030] For example, the OOIP (Original oil in place) may be estimated as:

$$\frac{V\ \phi\ NTG\ S}{B}$$

wherein V is the volume of the domain, ϕ is the mean value of the porosity, NTG is the mean value of the net-to-gross value, *S* is the saturation and, *B* is the expansion factor of the oil when it is extracted from the reservoir and stored at ambient pressure.

[0031] Once the facies has been generated and $f_i,\ \overline{\phi}_i, \phi_i^{max}, \phi_i^{min},\ i = 1..n$ variables are determined, the porosity is spatially distributed based on its statistical distribution $\overline{\phi}_i$, ϕ_i^{min}, ϕ_i^{max} by means of geo-statistical algorithm providing a predetermined longitudinal correlation equation and a predetermined orientation. In this case, the spatial distribution of the porosity is defined in each scenario of the plurality of scenarios.

[0032] After populating the porosity according to its statistical distribution, the longitudinal correlation equation and the orientation, the permeability property *(K)* is determined for each scenario.

[0033] To carry out this further step, the records of the analogues data base (2) have to comprise the permeability property of the materials and the porosity. From the selected records the correlation between the permeability versus the porosity is calculated wherein most of the cases the law between both variables is expressed as the logarithmic value of the permeability versus the porosity according to the Carman-Kozeny law. The selected records are those selected when the reference values ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\overline{\phi}_{ref}$ are obtained from the analogues data base (2).

[0034] According to the Carman-Kozeny law the equation

$$K = C\frac{\phi^3}{(1-\phi)^2}$$

is used to fit the scatter from the relation between permeability *(K)* and porosity (ϕ). The coefficient C can be estimated using a least square regression. To allow low scatter in the distribution further filters on the analogues results can be applied such as exploit possible correlation with additional variables as could be depth. The permeability variance has also been parametrized using a linear regression model as a function of porosity in order to correctly propagate the uncertainty in the three/dimensional realizations. To have a reliable simulation it is important to separate the effects of the mean (the trend) which is deterministic with porosity and the variance which is simulated by geo-statistical techniques.

[0035] The correlation law provides the scalar distribution of the permeability as a function of the porosity. By means of a geo statistical algorithm, for each domain of the generated scenarios the permeability as a scalar field is defined over said three-dimensional domain. For each scenario generated when the porosity has been populated, the geostatistical algorithm generates a plurality of scenarios taking into account the variability of the permeability property. Figure 4 shows the initial scalar data, the first group of scenarios generated when populating the porosity property taking into account uncertainty; and, according to the last step, the plurality of scenarios departing from each former scenario wherein this second generation of scenarios provides the variability of the permeability taking into account how the uncertainty for said permeability property is propagated.

[0036] Once the porosity and the permeability has been distributed in the second generation of scenarios, according to a further embodiment of the invention the water saturation is calculated. To compute initial water saturation and later the net-to-gross, the results for analogous have been further exploit.

[0037] In this case, the selected records, those selected when the reference values ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\overline{\phi}_{ref}$ are obtained from the analogues data base (2), also comprises the water saturation, or data on water saturation allowing to calculate the $\overline{S}$ for instance by means of correlations taking into account several properties different from the water saturation.

[0038] For the m selected records, being m > n, using the mean porosity conditioned on facies computed in the optimization algorithm together with the mean per each analogues *j* we can express the following over determined system of m equations:

$$\sum_{i=1}^{n} \tilde{f}_i \bar{\Phi}_i = \bar{\Phi}_{an,j}$$

is solved preferably by least square method. The equation $\sum_{i=1}^{n} \tilde{f}_i \bar{\Phi}_i = \bar{\Phi}_{an,j}$ is defined for all j = 1,...,m selected records of the analogues data base (2) and the n unknowns, the facies proportion per analogue, $\tilde{f}_i$ i = 1, ..., n.

[0039] Analogously the system of equations

$$\bar{S}_{an,j} = \sum_{i=1}^{n} \tilde{f}_i \bar{S}_i$$

and

$$\overline{NTG}_{an,j} = \sum_{i=1}^{n} \tilde{f}_i \overline{NTG}_i$$

are specify for water saturation and net-to-gross calculation. In this case, the facies proportion per analogue, $\tilde{f}_i$ i = 1,...,n is known from the former system and the mean of the water saturation for each facies and the mean of the net-to-gross also for each facies is obtained by solving the over determined system, for instance, by least square method.

Claims

1. Method to generate scenarios of hydrocarbon reservoirs based on limited amount of information on a target hydrocarbon reservoir, comprising the steps:

a. compile information on the target hydrocarbon reservoir,

b. providing an integer number n of facies, preferably between 1 and 8, comprised in the domain of the scenario modeling the target hydrocarbon reservoir, wherein each facies F_i, i = 1..n, is modeled by its partial rate f_i, and a normal distribution of the porosity having a mean value $\overline{\phi}_i$ and the cutoff values ϕ_i^{min} and ϕ_i^{max} for a predetermined threshold such that the area of the tail of the normal distribution is deemed to be neglectible beyond such threshold, subject to the following restrictions:

- $\bar{\phi}_i < \bar{\phi}_{i+1}$ $i = 1..n - 1$
- $\bar{\phi}_i = (\phi_i^{max} - \phi_i^{min})/2$
- $\sum_{i=1}^{n} f_i = 1$

c. determining ϕ_{ref}^{min}, ϕ_{ref}^{max}, and the $\bar{\phi}_{ref}$ values,

d. determining $f_i, \bar{\phi}_i, \phi_i^{max}, \phi_i^{min}, i = 1..n$ as the solution of a minimization problem wherein the cost function is defined by the expression

$$Min\left(\| \phi_{left}^{min} - \phi_{ref}^{min} \| + \left\| \bar{\phi}_{ref} - \sum_{i=1}^{n} f_i \bar{\phi}_i \right\| + \| \phi_{right}^{max} - \phi_{ref}^{max} \| \right)$$

wherein ϕ_{left}^{min} and ϕ_{right}^{max} is defined by the condition

$$\phi_{left}^{min} = Min(\phi_i^{min}); i = 1, \ldots, n$$

$$\phi_{right}^{max} = Max(\phi_i^{max}); i = 1, \ldots, n$$

e. generating a plurality of three-dimensional scenarios having a three-dimensional domain and the shape of the n facies by means of a multipoint statistical method, preferably a Sequential Indicator Simulation, wherein multipoint statistical method is restricted to the number of facies *n,* the partial rates of facies f_i, $i = 1..n$.

2. Method according to claim 1 wherein it further comprises providing an analog data base comprising records of known reservoirs wherein each record comprises scalar data of material properties for determining values such as facies properties.

3. Method according to claim 1 and 2 wherein the ϕ_{ref}^{min}, ϕ_{ref}^{max}, and $\bar{\phi}_{ref}$ values are obtained as follows:

1. when providing an analog data base comprising records of known reservoirs, at least one record further comprises the porosity of the material, that is, the minimum value ϕ_{an}^{min} of the porosity, the mean value $\bar{\phi}_{an}$ of the porosity, and the maximum value ϕ_{an}^{max} of the porosity,
2. when compiling information on the target hydrocarbon reservoir in step a), such information has at least a material property among the material properties comprised in the records of the analog data base,
3. provide a similarity criterion for the comparison of reservoirs sharing at least a common material property,
4. select the set of *m* records in the analog data base meeting the similarity criterion with the target reservoir, wherein at least one record of the selected record comprises the porosity of the material,
5. when determining ϕ_{ref}^{min}, ϕ_{ref}^{max}, and the $\bar{\phi}_{ref}$ values in step c), such values are obtained for the set of records of the analog data base selected in step 4) as:

- $\phi_{ref}^{min} = Mean(\phi_{an,j}^{min})\ j = 1 \ldots m$
- $\bar{\phi}_{ref} = Mean(\bar{\phi}_{an,j}) j = 1...m$; and,
- $\phi_{ref}^{max} = Mean(\phi_{an,j}^{max})\ j = 1 \ldots m$ for all records having the porosity in formation.

4. Method according to claim 1 and 2, and any of previous claims wherein:

- the records of the analog data base further comprises volumetric data such as the reservoir area and thickness, NTG (net-to-gross) and saturation information,
- when generating a plurality of three-dimensional scenarios on step e) having a three-dimensional domain, the domain is generated randomly from a multidimensional correlation between area and thickness and has a volume verifying that is big enough to store the oil calculated according to the volumetric data.

5. Method according to any of previous claims wherein the multipoint statistical method for generating the plurality of three-dimensional scenarios is restricted in each scenario to the number of facies *n,* the partial rates of facies f_i, i = 1..*n*, and the property ϕ is spatially distributed based on its statistical distribution $\overline{\phi_i}$, ϕ_i^{min}, ϕ_i^{max} by means of geo-statistical algorithm and also to a predetermined longitudinal correlation equation and a predetermined orientation.

6. Method according to any previous claim and in particular claim 2, wherein a plurality of records of the analog data base further comprises the permeability (K) property of the materials and the porosity,

- determining a correlation between the permeability versus the porosity, preferably the Carman-Kozeny law expressed as the logarithmic value of the permeability versus the porosity, obtained from the set of analog data base records selected in step 4) in claim 3,
- the dispersion of the former law is obtained from the same set of analog data base records selected in step 4) in claim 3,
- the permeability as a scalar field defined over the three-dimensional domain for each three-dimensional scenario is generated based on the correlation between permeability and porosity and its variability by means of geo-statistical algorithm.

7. Method according claim 1, 2 and 3; and to any previous claim wherein the m selected records on step 4 of claim 3 of the analog data base further comprises the water saturation values of the materials $\overline{S}$, or, data on water saturation allowing to calculate the $\overline{S}$, form such data by postprocessing and the average water saturation for each facies is calculated as follows:

- for the m selected records, being *m* > *n,* solving the over determined system of *m* equations, preferably by mean square method:

$$\sum_{i=1}^{\dot{n}} \widetilde{f_i}\, \bar{\Phi}_i = \bar{\Phi}_{an,j}$$

for all *j* = 1,...,*m* records of the analogues data base and the *n* unknowns $\widetilde{f_i}\ i$ = 1, ...,*n*;
being $\overline{\phi_i}$ the mean porosity for each facie F_i, i = 1.. *n* calculated on step e); and, $\overline{\phi}_{an,j}\ j$ = 1, ...,*m* the mean values of the m selected records obtained from the analogues data base,
- for each facies F_i, i = 1..*n*, the average value of the saturation $\overline{S_i}$ is calculated by solving the over determined system of equations, preferably the by least square method:

$$\sum_{i=1}^{n} \widetilde{f_i}\, \bar{S}_i = \bar{S}_{an,j}$$

8. Method according claim 1, 2 and 3; and to any previous claim wherein the *m* selected records on step 4 of claim 3 of the analog data base further comprises the net-to-gross NTG values of the materials $\overline{NTG}$,; or, data on net-to-gross NTG allowing to calculate the $\overline{NTG}$, form such data by postprocessing and the average NTG for each facies is calculated as follows:

- for the m selected records, being $m > n$, solving the over determined system of m equations, preferably by mean square method:

$$\sum_{i=1}^{n} \tilde{f}_i \bar{\Phi}_i = \bar{\Phi}_{an,j}$$

for all $j = 1,...,m$ records of the analogues data base and the n unknowns $\tilde{f}_i$ $i = 1, ...,n$;
being $\bar{\phi}_i$ the mean porosity for each facie F_i, $i = 1.. n$ calculated on step e); and, $\bar{\phi}_{an,j}$ 7 = 1, ...,m the mean values of the m selected records obtained from the analogues data base,
- for each facies F_i, $i = 1..n$, the average value of the net-to-gross $\overline{NTG}_i$ is calculated by solving the over determined system of equations, preferably the by least square method:

$$\sum_{i=1}^{n} \tilde{f}_i \overline{NTG}_i = \overline{NTG}_{an,j}$$

9. A data processing system comprising means for carrying out a method according to any of claims 1 to 8.

10. A computer program product adapted to perform a method according to any of claims 1 to 8.

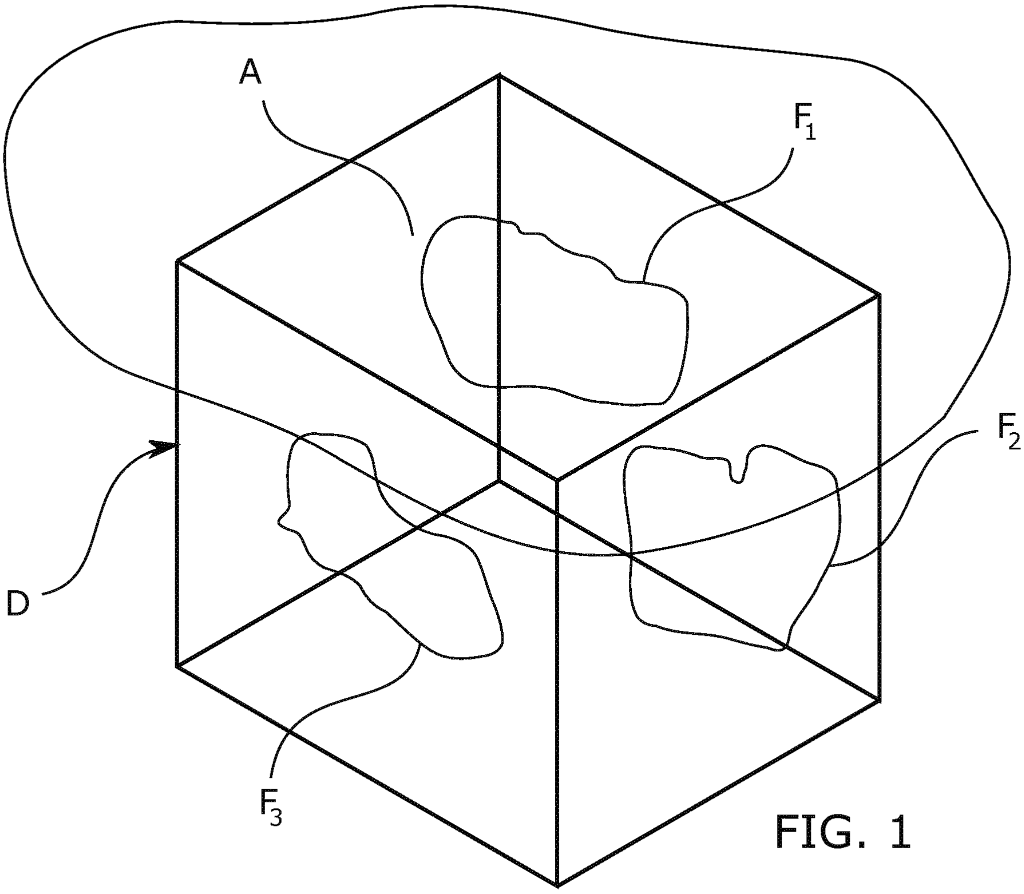


FIG. 1

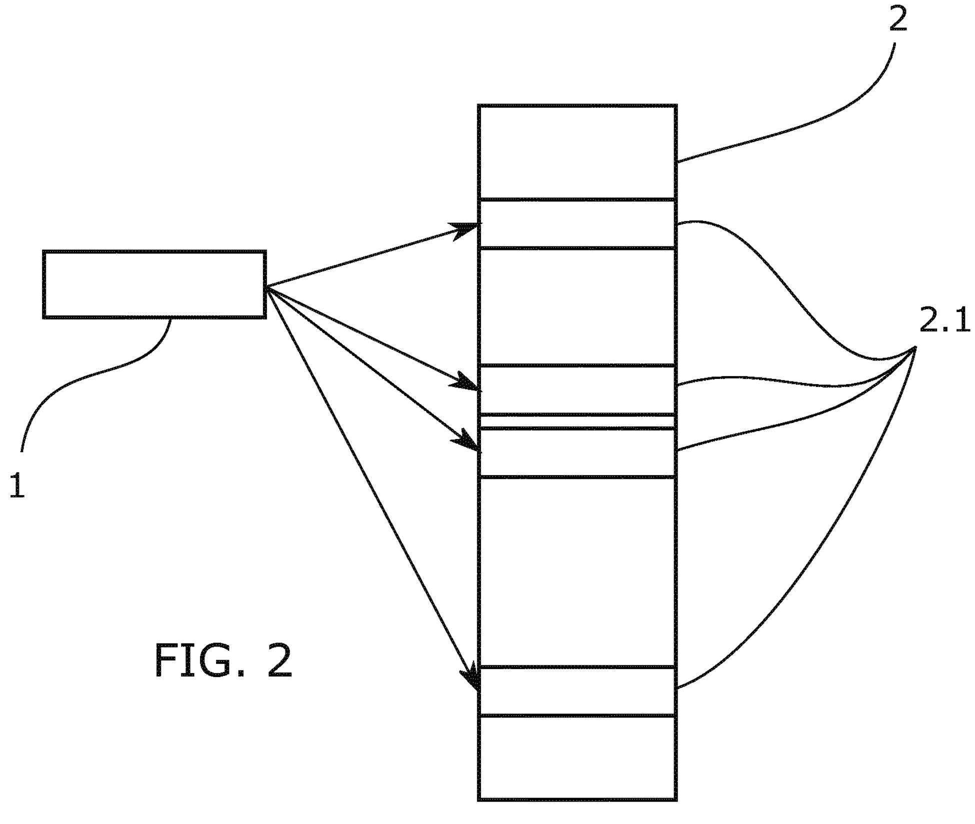
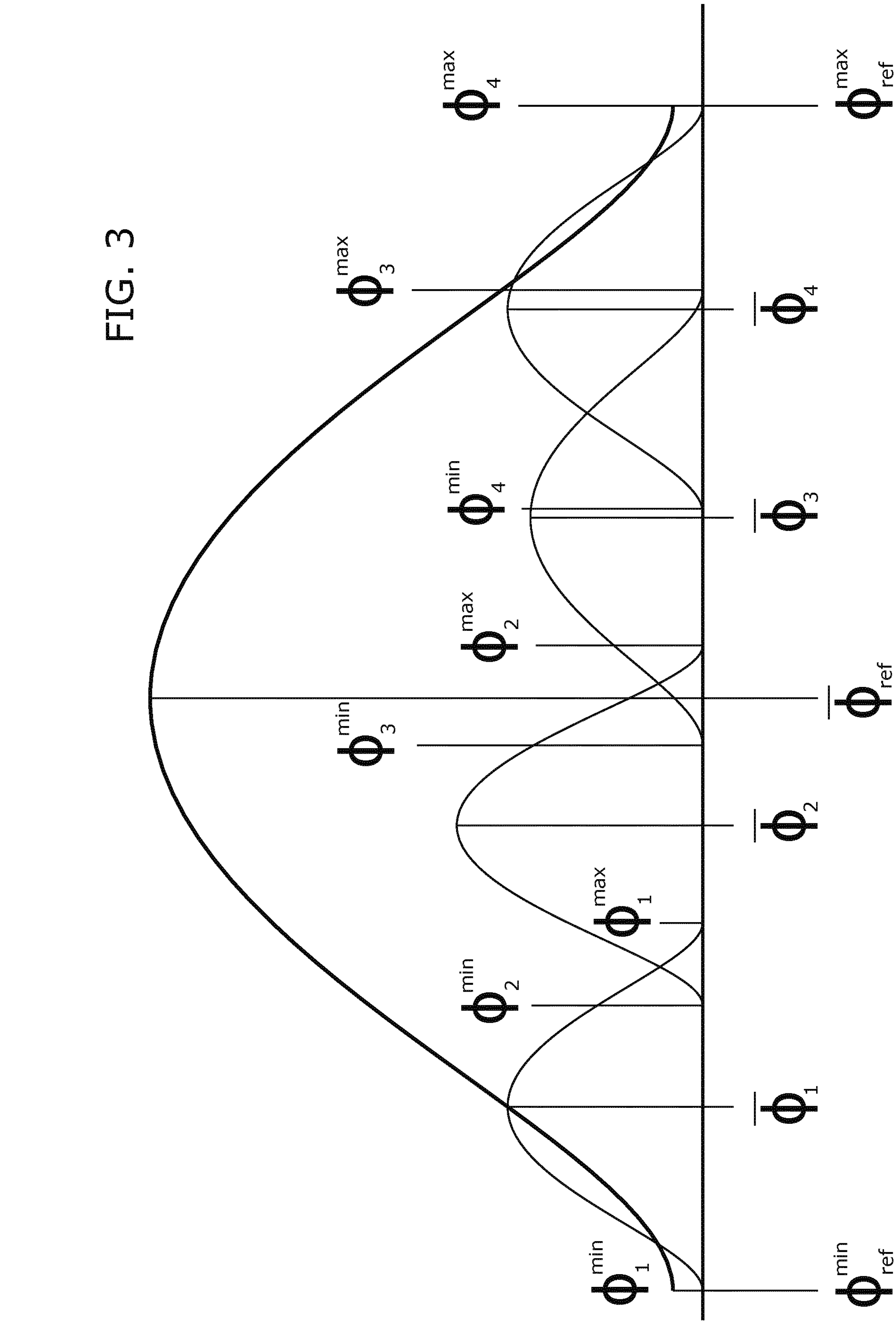


FIG. 2



ϕ_1^{min}
ϕ_2^{min}
ϕ_1^{max}
ϕ_3^{min}
ϕ_2^{max}
ϕ_4^{min}
ϕ_3^{max}
ϕ_4^{max}
ϕ_{ref}^{min}
$\bar{\phi}_1$
$\bar{\phi}_2$
$\bar{\phi}_{ref}$
$\bar{\phi}_3$
$\bar{\phi}_4$
ϕ_{ref}^{max}

FIG. 3

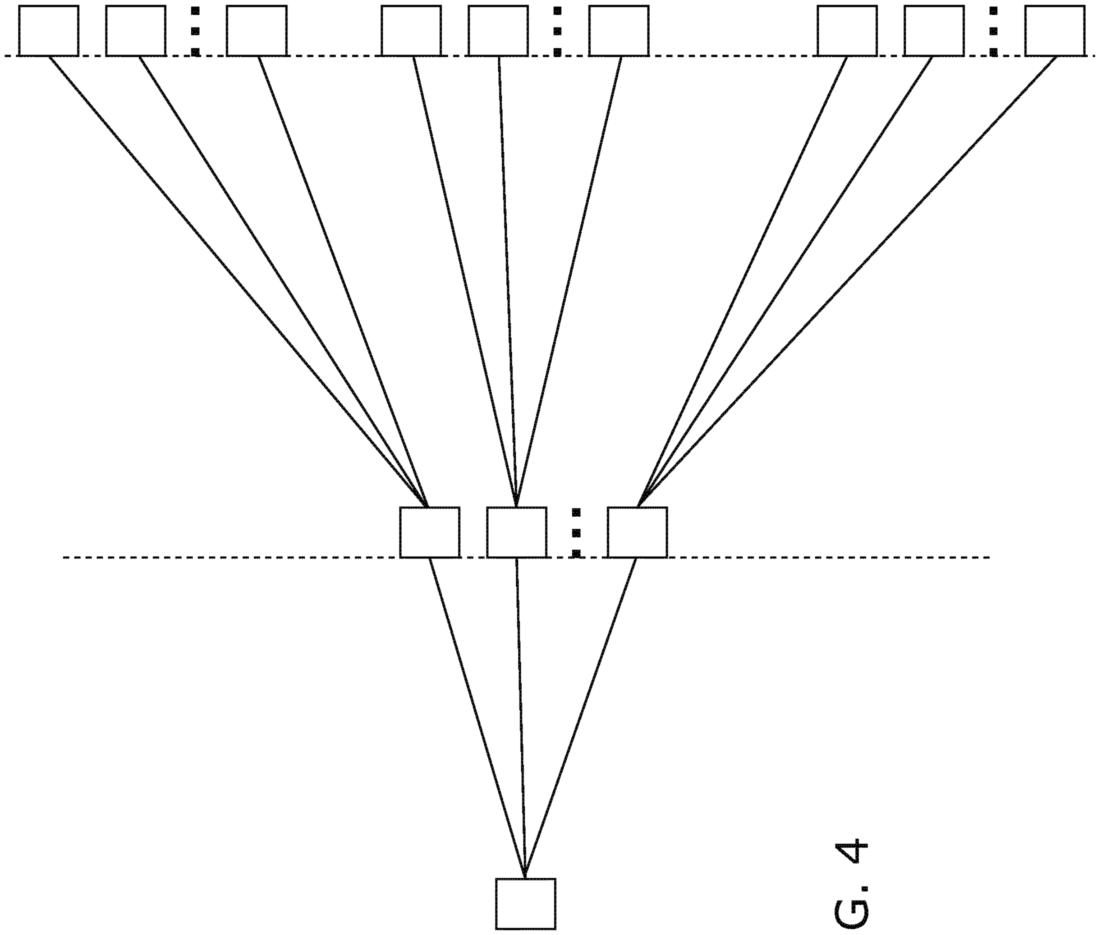


FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 38 2254

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2009/145960 A1 (EXXONMOBIL UPSTREAM RES CO [US]; FURMAN KEVIN C [US]; GOEL VIKAS [US]) 3 December 2009 (2009-12-03) * paragraph [0003] - paragraph [0006] * * paragraph [0008] - paragraph [0011] * * paragraph [0022] - paragraph [0023] * -----	1-10	INV. G06Q50/02
X	US 2011/118983 A1 (ROWAN DANA E [US]) 19 May 2011 (2011-05-19) * paragraph [0001] - paragraph [0016] * -----	1-10	
A	Jef Caers ET AL: "Multiple-point geostatistics: a quantitative vehicle for integrating geologic analogs into multiple reservoir models", , 2 January 2002 (2002-01-02), XP055085091, Retrieved from the Internet: URL:http://citeseerx.ist.psu.edu/viewdoc/download?rep=rep1&type=pdf&doi=10.1.1.218.1571 [retrieved on 2013-10-23] * page 5 - page 6 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (IPC) G06Q

1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 October 2013	Hasubek, Bodo

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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