9th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2012"

P-137

Practice of seismic-gravimetrical modelling

A.A.Chernov*, *Pangea Inc.*, ***V.A.Boldyreva,*** *IGIRGI*

Summary

The prospects of detection of HC deposits in the Timan-Pechora province contact byreef structures in Ust-Pechora carbonate sediments of Upper Devonian. The interpretation of gravitational anomalies was directed on revealing and mapping of reefs and connected with by them decompactions – potential traps HC. The prospects of the decision were estimated proceeding from results of researches of gravitational fields anomalies above buried reefs structures in various oil content areas. Revealed thus by the numerous researchers of law of display of reefs in gravitational fields testify as to potential opportunities of gravity by searches of buried reefs, and allow to make a choice of techniques of interpretation of a gravitational field.

Keywords*: Gravity, seismic, modeling, density, geological section, bedding, structure cut.*

Introduction

Construction of density models of a geological section (gravitational modelling) is one of the major procedures: whether only results of modelling can show there correspond the made constructions to observed fields (i.e., whether they are real). At similar modelling by the initial information are depths of bedding of structurally-density complexes (defined on the seismic and geological data). Selection of parameters of model of the geological environment generating anomalies of geophysical fields is carried out.

Methods

At presence in a geological section of studied area gravitating structural surfaces the effect from which can level effect from HC trap, or in the presence of the geological factors causing gravitational anomalies hindrances, "the clarification" problem of observed gravitational field from influence of these factors resolve: geological reduction. The cleared gravitational field is exposed to certain transformations, for the purpose of revealing in a geological section of sites of density heterogeneities. Three elements of a geology-geophysical situation − a contact surface, a background of extraneous influences, density distribution − are formed and will mutually be co-ordinated in the iterative process which sense consists in construction of the complete model respondent to the observed data and to laws of the geological environment. Thus in a certain measure incompleteness and an inaccuracy of the primary data (in particular, about density) on the basis of the account of data on laws and parities in the geological environment is compensated.

Russia, 109004, Moscow, Alexandra Soljenizina, 27, Pangea. chernov_aa@pangea.ru
Russia, 119334, Moscow, Fersmana, 50.

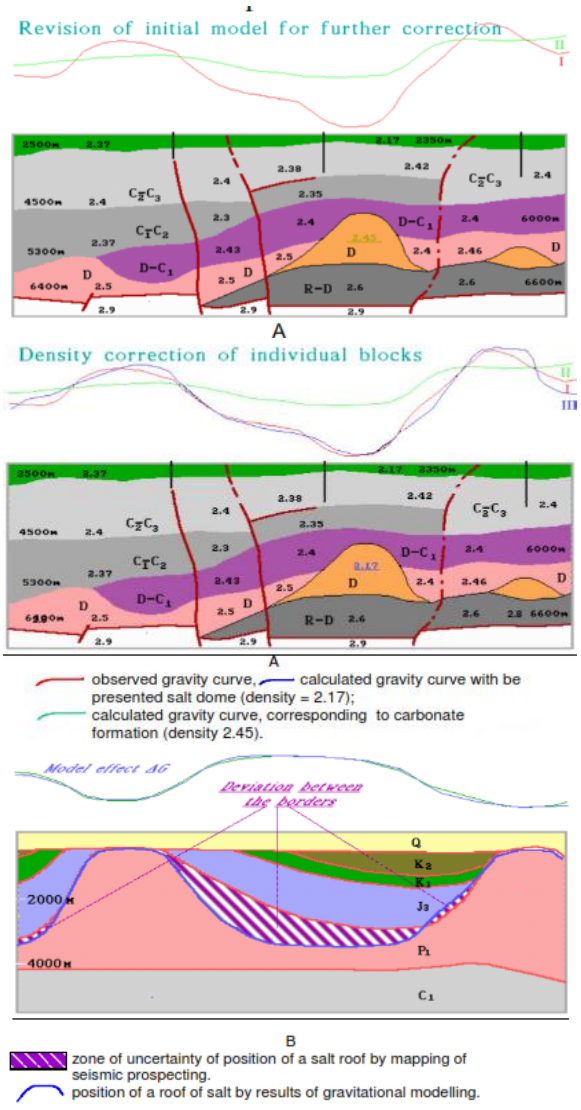

Fig. 1. Modelling of sections in the environment of salt-dome tectonics (Karachgganak deposit).

Materials

Most widespread complex interpretation seismic and gravimetric data in areas of salt-dome tectonics. On fig. 1 modelling has revealed a salt dome, in a counterbalance to initial representation about carbonate filling of the revealed formation. A Fig. 1-Б - specification of position of a roof of salt on a slope of a dome and at mould. The data resulted on fig. 2, shows possibilities gravitational exploration at control and addition of seismic constructions. In the bottom part of picture the red accepts position of a hypothetical salt dome according by seismic prospecting. The curve of gravity corresponding to a dome (it is shown dark blue) does not answer to the observed gravity data while alternative construction causes full coincidence computed and observed diagrams.

The black shale deposit the Dry Ravine is located within Bodajbinsky synclinorium. In area concerning the lowered field the local Ugahansky minimum of gravity for which borders are dated both Konstantinovsky massive, and a deposit the Dry Ravine is allocated. In the area of the raised field the Kropotkinsky local maximum Δg settles down (fig. 3).

A source platinum and gold mineralization around a deposit the Dry Ravine are traced by gravimetric data in the basis Bodajbinsky synclinorium bazit-giperbazit rocks by Early Pre-Cambrian base. Ugahansky granite pluton (cryptobatholite) in the plan it is fixed by negative ellipse anomaly amplitude of an order 6- 7mgl. For specification of a configuration of a granite body and definition of other parametres of a section gravitational modelling in an interactive mode is spent: It is as a result established that Ugahansky pluton represents the body of the oval form close coinciding on a configuration with the local minimum with the same name Δg. Its area – nearby 110km2, thickness – to 6km (fig. 3).

Gravitational modelling has unequivocally shown that the most part of the base of area is combined by rocks of considerable density with σ = 2.80g/sm^3. It is the most probable that it metamorphic and the metavolcanic rocks of high basicity composing Early Pre-Cambrian basis of region. Thus to the Kropotkinsky maximum Δg corresponds subisometric body with σ = 2.94g/sm^3, located in the base. Main ore-forming factor is Paleozoic Ugahansky granite cryptobatholite which hydrothermal activity has caused carrying over and concentration a platino-gold mineralization that finally has led to deposit formation. At last, ore bearing are Late Proterozoic carbonaceous slates by Homolhinsky suite.

Complex interpretation by seismic and gravimetric data on the regional profile crossing from the West on the East the Verhne-Kamsky depression the Bashkir arch and the Jurjuzano- Ajsky hollow has revealed essential differentiation of abnormal curve that is specifies in high degree of density heterogeneity of the top part of a

section. The time cross-section by character of a wave field (especially in the range of registration roof Proterozoic deposit) is characterised by alternation of stronger and sustained reflexions with zones of weak, faltering and chaotic reflexions, presence of different type of the waves-hindrances, the raised development of zones of explosive disturbance. On a time cross-section number of stratigraphical adhered seismic borders between seismo-stratigraphical units of a different rank on which, as a rule, there is a change of drawing of a seismic recording is allocated. The carried out analysis has shown that on a cut two are allocated formation systems – avlakogenious by Riphean and slabby by Vend- Cainozoic.

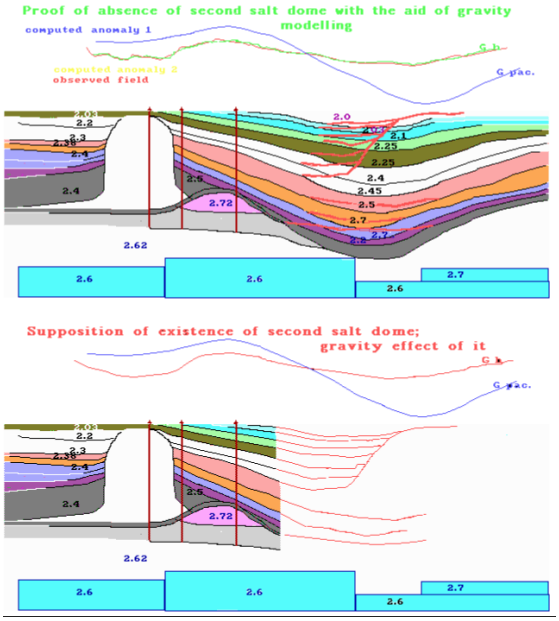

Fig.2. Modelling of sections in the environment of salt-dome tectonics Complexation of seismic- gravity data in the area of distribution of salt- dome tectonics. The salt dome allocated by seismic prospecting does not correspond to gravimetrical data.

Differentiation of density characteristics of carboniferousdeposits corresponds to the local extrema of a gravitational field characterised in the insignificant sizes in the plan and sharp gradients. The satisfactory decision is obtained by means of 1)differentiations density characteristics obtained on the basis of conversion speed-density, 2) a choice of a new variant of correlation of a time cross-section.

Leading method – seismic prospecting – in many cases meets serious difficulties at mapping of the majority of types of not anticlinal traps. For example, for land cones of carrying out (traps epicontinental basins) characterised by the raised capacities in comparison with one-age background deposits and linear oblongness, are typical either total absence of a seismic recording or sketchy chaotic reflexions. Often over them reflexions reduce the dynamic expressiveness. Bodies river race differ absence of the sustained reflexions; for them presence of the faltering bent axes of phase synchronism is characteristic. For intrashelf reefes deterioration of a seismic recording before full loss of correlation of deposit is characteristic. In them the curvature and intermittence of axes of phase synchronism (often they get inclined character) is observed.

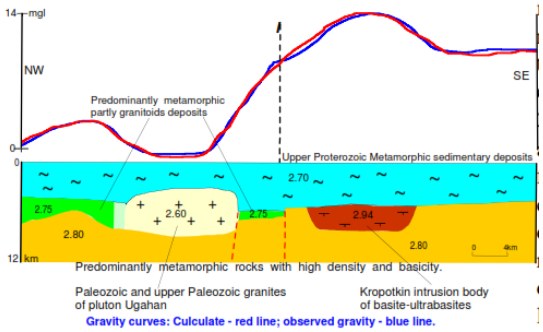

Fig. 3. Schematic density section through pluton which control deposit Dry ravine.

For intrashelf reefs are characteristic diffracting waves and presence of loops. For barrier reefs sharp deterioration of a seismic recording is characteristic. In them the curvature and intermittence of axes of phase synchronism is observed. Zones of secondary cracking are characterized by sharp deterioration of dynamics of reflexions before their almost full attenuation and occurrence of a transparent seismic recording, etc.

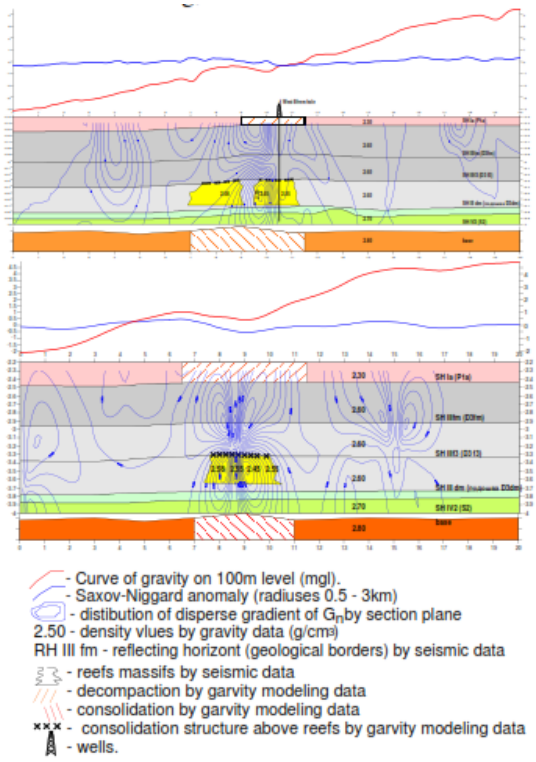

Fig. 4. Density models through studied bioherm massif were constructed taking into account an arrangement of singular points of a field.

At the same time, in overwhelming majority of cases of structure of complex construction traps of various types mandatory are reflected in a gravitational field. For example, gravitational modelling of a trap of pinching-out and lithologic replacements, having the wedge form, has shown that at the effective density of a layer-collector equal to 0.2g/sm^3, at bedding depth of layer from 2 to 3 km, and horizontal sizes - from 3 to 5 km and at corner of pinching-out in 1°, the effect from pinching-out or a replaced part of a layer changes from 0,06mgl to 0,50mgl. The Shaimsky deposit (Western Siberia) on character of restriction of a collector and confined to it of oil deposits concerns it to bazal-lithologic type lithologic-stratigraphic traps. Traps are dated to bazal nontight layers in the cover basis. These layers pinching-out to axial zones of structure of the first and second order, form a deposit in structural gulfs. From observed gravitational field here are allocated low amplitude local anomaly in the form of a step which will well be coordinated in the plan with the line established according to drilling pinching-out a productive layer of vogulkinsky suite.

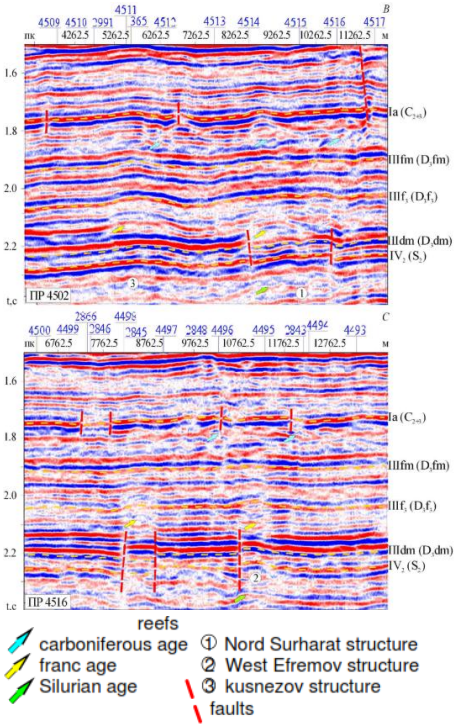

Fig. 5. Character of a seismic recording in zones of prospective development bioherming formations of carboniferous age.

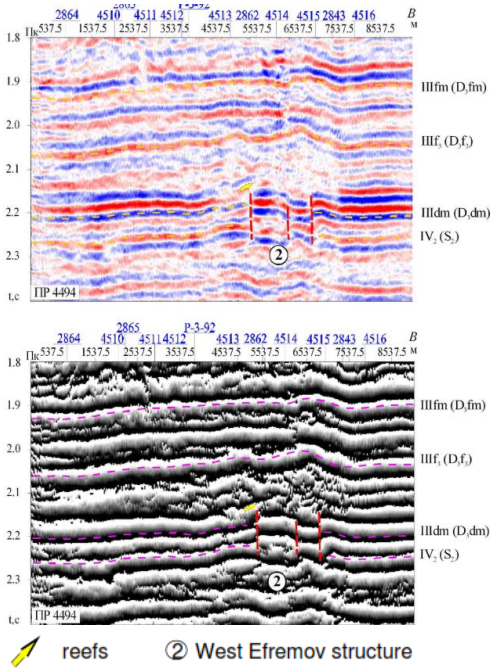

Fig. 6. Character of change of a seismic recording in zones of prospective development reef-genic formations on time cross-section (a) and phase section (b).

Prospects of the studied area in the Pechora region are connect with HC deposits in ust- Pechora carbonate deposits Devonian top within a zone assumed organogenic constructions. Revealing and mapping reefs and connected with them decompactions – potential HC traps was carried out by means of interpretation of gravitational anomalies (fig. 4). The greatest practical interest represent frank famensky deposits. A roof of rocks frank age connect with reflect IIIf3.

Conclusion

Interactive selection of density and geometrical properties of a section with use of all aprioristic data, provides creation of model of a structure of the geological environment were saturated densities (petrophysical) properties. Most physically proved and geological effective is complexation of seismic prospecting and gravimetric prospecting. First of all it is predetermined by a generality of geologo- physical model: reflecting borders always are at the same time are densities, and variations of density and seismic waves speed are closely connected. Communication of values of density of rocks and their structure with efficiency prospects is shown.

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