8th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2010"

P-418

The oil and gas deposits potential of Paleozoic sediments at North Caucasus.

*A.A.Chernov** *(Pangea Inc.),* **V.A.Boldyreva** *(IGIRGI),* **E.A.Trofimenko** *(ZAO "Sevkazgeoprom")*

Summary

The mapping of local decompactions in Paleozoic deposits in section is carried out. It is carried out on the basis of the analysis of precision gravity within the limits of Baydjanovskoe and East deposits, concerning a number of deposits of Prikumskaya raisings system. The gravity analysis was carried out on the developed specialized technique successfully enough used in a number of oil bearing areas. The features of character of a gravitational field above some HC traps testify, on the one hand – to an opportunity and necessity of use of the data precision gravity for the forecast of presence of oil and gas, with another – about necessity of development and introduction of more perfect methods of interpretation.

Introduction

Now gain of stocks of petroleum in Paleozoic sediments of Predkavkazye can be essentially is increased at the expense of use of not seismic methods – precision gravity and magnetic with application of special methods of interpretation. Specialized interpretations methods must not only reveal local decompactions in a geological section, but also establish criteria of forecasting of probable efficiency of its productivity, and also determine its deep and spatial parameters.

Such techniques are capable to allocate the strongly shaded effects and to define on them parameters of required object [3, 4]. They permit to predict decompaction, shown in a complex geological section.

Theory and Method

At presence in a geological section structural surfaces which gravitational effect can damp effect from a HC trap, or at presence of the geological factors causing gravitational anomalies-hindrances, is made observed gravitational field purification from influence of these factors.

The method of pseudo-magnetic anomalies at gravitational and magnetic anomalies monogenetic is applied to exception of strongly gravitational objects effects from observed gravity [2, 3, 4]. The method is based on connection between gravitational and magnetic fields described by the Poisson equation. The method geological reducing is used for moving off from observed field a gravitational effect from geological structures both allocation and amplification of effect from local decompaction. Thus, as a result of geological reducing from observed field the effects caused by density subhorizontal complexes at constant value of density inside these complexes are subtracted. Hence, the calculated residual gravitational field will reflect influence of density heterogeneities inside these complexes, and also the influence of required deposits, and also underlay masses.

On the following investigation phase the residual gravitational field is exposed to transformation by a method "GRADDIS" [3, 4]. The dispersion analysis of a field G_n includes:

1. Calculation of the complete normalized gradient of gravity at the given levels in a plane of a section.
2. Calculation of dispersion at the same levels.
3. Calculation of a gradient of dispersion at the same levels.

By results of this transformation in a geological section the sites of density heterogeneities are allocated. In a basis of a method idea consisting is fixed that local density heterogeneity of a geological section is characterized by

Pangea Inc. 27 Alexander Solzhenitsyn Street, Moscow 109004, chernov_aa@pangea.ru

variability of density. This density variability is shown in variability of a gravitational field in a section, its increased disperse on a site of local heterogeneity. This effect amplifies at the expense of disperse recalculation in its vertical gradient. Field of the Total Normalized Gradient (TNG, G_n) by V.M.Berezkin [1] does not contain a regional component of a section. In it the singular points of a field, including connected with local density heterogeneity are shown. Such sites are the areas increased porosity, jointing. The variability can be strengthened for the due to oil saturation. The similar sites are shown by maxima of a disperse gradient of a TNG field. The representation of initial function by Fourier series and realization of calculation G_n on the basis of Fourier series is connected to a choice of an optimum harmonic of decomposition. The choice of meaning of a harmonic is one of the basic methodical problems at use of a method of the total normalized gradient and, accordingly, gradient of it dispersion. Choice of harmonic number define the degree frequency filtrations of observe gravitational field and, accordingly, allocation of this or that component. We for a choice of an optimum harmonic decomposition value have developed reception of "adjustment" on an optimum harmonic on a standard site [3]. For adjustment the profile (or number of profile gets out, where there are data on presence of required object (deposit). The optimum value of a harmonic of decomposition equal to a volume is established, at which greatest correspond to sites of a section in area of productive wells on size maxima of disperse gradients at the same depths.

The revealed thus features of a field in the areas of productive and unproductive wells can be accepted for criterion of forecasting not only search object, but also its productivity. The subsequent stage of interpretation is the realization of gravitational modeling. The data of density heterogeneities depths, received on a method "GRADDIS" are taken into account. A final stage of interpretation drawing up of the schemes of distribution of rocks density for investigated of lithology-stratigraphic complexes.

Results of researches

The gravitational field in investigated territory (within the limits of Baydjanovskoe and East deposits) is submitted by a large maximum complicated by local anomalies. Gradient zone without seen displays on it a local complications there corresponds by Baydjanovskaya structure. The loss amplitude local gravitational maximum is observed above East structure. At top analytic continuation of gravitational anomalies above East structure the local positive anomaly is levelling and at a level of 2 kms disappears completely. At visual comparison a gravity magnetic maps it is visible, that large elements of fields monogenetic. Sedimentary cover is practically no magnetic. Hence, the regional gravitational maximum is caused by the deep factor. Its influence was excluded by recalculation of a magnetic field in pseudo-gravitational field, which was deducted from observed gravitational field.

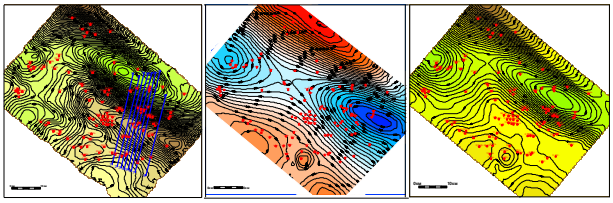

Fig.1. a – observed gravitational field; b – observed magnetic field; c – residual field (observed gravitational field minus pseudo gravitational field).

Granitoids in Predkavkazye were disclosed on many areas of deep prospecting drilling. The structure of them is rather simple, but the quantitative ratio of minerals widely vary with formation of a number a granite (plagiogranite) – granodiorite – quartz diorite (tonalite). It are seldom marked diorites. The main minerals are submitted by plagioclase, microcline and quartz. Minor – biotite, muscovite. Secondary – calcite, chlorite, sericite, kaolin. Auxilary minerals – apatite, zircon, titanite, rutile and magnetite. The secondary changes often are expressed in replacement on biotite cracks by green chlorite with allocation amorphous magnetite. Therefore range of change density and magnetic properties of Granitoids is wide enough. Thus, it is inconvenient to determine by these data Poisson coefficient value, and the statistical approach was applied for its definition. The criterion of a minimum of root-mean-square of a deviation of meanings of observed gravity and calculated pseudo-gravitational field is used. Received by this way the residual gravitational field substantially is released from influence of heterogeneity of deep layers. This field was exposed to the further analysis.

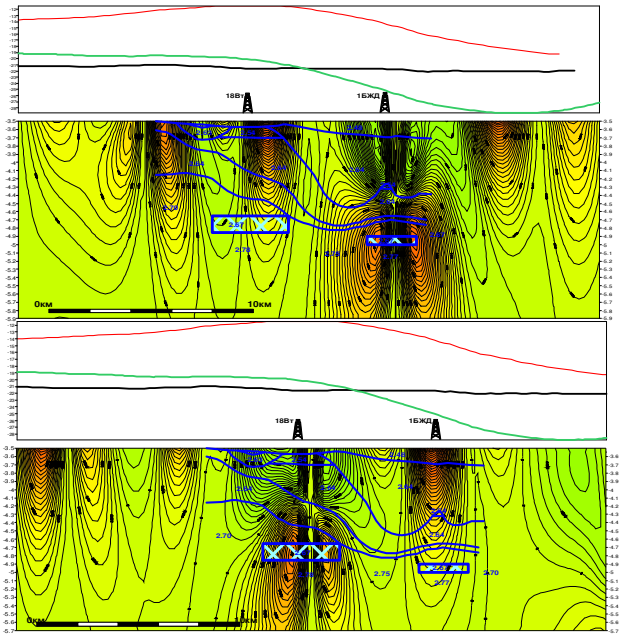

Fig. 2. Density section. Structure surfaces by seismic. Observed gravitational field. residual field. residual of gravitational and pseudogravitational fields; decompactions in Paleozoic deposits. 2.4g/cm^3 – density values.

The forecast of decompactions in geological section was carried out by a field released from gravitational influence of the structural factor of sedimentary bed. By means of procedures of removal of a regional background and geological reducing it was possible to allocate local minima above investigated structures. For definition in a section of a decompactions sites, which the revealed minima are caused by, the method "GRADDIS" was used. I.e., it was possible to allocate local minima above investigated structures. On East and Baydjanovskaya structures are revealed oil delfs in Triassic deposits on depths 3570 and 4200m. This information was used as standard. The disperse gradients of TNG of residual anomaly were designed at a set of harmonics, since 10. On depths of delfs in Triassic deposits both on East, and on Baydjanovskaya structures the maxima of disperse gradients are received at harmonics of decomposition 31 (East structure) and 24 (Baydjanovskaya structure).

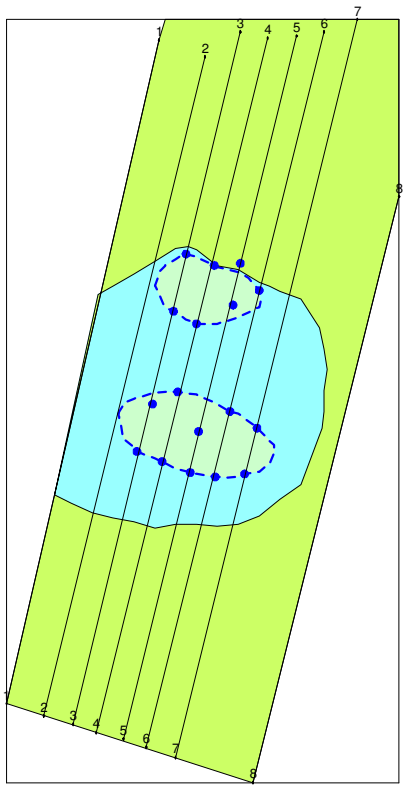

Fig. 3. Scheme of decompactions in Paleozoic sedimentations by gravity data. Vostochnoe and Baydjanovskoe structures area. interpretation lines, contur of decompactions in Paleozoic sedimentations , 2.65 - density values (g/cm3), Paleozoic sedimentations with density ≤2.75, ≥2.70, - TNG dispersion gradient maxima situation. 2 - interpretattion lines numbers.

Thus, on standard objects – delfs of petroleum in Triassic deposits within the limits of East and Baydjanovskaya of structures, is shown, that the delfs are shown in a field of disperse gradients. The specified harmonics values were used for forecasting potential decompactions in an interval of the appropriate depths. The interval of depths was determined proceeding from gravitational field downward continuation (from a Paleozoic deposits surface to depth 6km) character. The maximal values of a disperse gradient in a Paleozoic deposits section are marked on East structure on depth 4500m at a harmonic 29+30, Baydjanovskaya – 5000m at a harmonic 27 (fig. 2).

Conclusion

So, with use of a method "GRADDIS" the information on depths of density heterogeneities bedding in Paleozoic deposits on the area of Baydjanovskaya and East structures is received. As a result of modeling the meaning of deficiency of density 0.1g/cm^3 is found. For East structure decompaction in Paleozoic deposits is located on depth 4650m and has thickness 200m at the horizontal sizes in 3500m. For Baydjanovskaya structure these parameters make accordingly 4900m, 100m, 2200m. The scheme of decompaction in Paleozoic deposits is made, where the decompaction contours are allocated within the limits of both structures. By porosity value revealed by gravity data decompactions in Paleozoic deposits can be of interest, as object of search of deposits of petroleum. The received result gives a positive estimation of oil perspective of Paleozoic deposits.

Reference

V.A.Boldyreva, A.A.Chernov A.A., A.N.Zaitsev. [2003]. Computer technologies of interpretation of gravity and magnetic data for forecasting perspective zones and HC deposits in conditions of Western Siberia. Proceedings of SEG-2003 Conference&Exibition. OS9. Moscow.

Chernov A.A. [2004]. Using gravity and magnetic data for geological mapping. 32nd International Geological Congress. FLORENCE, from 20/08/04 to 28/08/04. Proceedings. Session "G20.01"

Chernov A.A. [2004]. Development of geopotential data interpretation methods. “Geofizika”, EAGE, Moscow, № 3, p.45-51.