ESTIMATION OF EFFICIENCY LITHOGEOCHEMICAL SURVEYS FOR PETROLEUM AND GAS PROSPECTING

Anastasia Moshchenko
Moscow State University
119234 Moscow Vorob'evy Gory, MSU, geochemistry department
moschenko@mail.ru

INFO

SUMMARY

The paper describes application of litho geochemical surveys for petroleum and gas prospecting within direct detection of hydrocarbons escaping from subsurface accumulations and source beds – most common technique.

The geochemical data came from shallow probes soil samples and shallow probes of soil gas. The adsorbed soil gases were analyzed for methane, ethane, ethylene, propane, propylene, iso-butane and normal butane by gas chromatography using a Flame Ionization detector. Samples of soil were analyzed for number of elements using spectral analysis.

Direct relationships between distribution of hydrocarbons and certain elements in the vicinity of oil and gas accumulations were discovered. Those elements form halos marking structures perspective for oil and gas (Ni, Co, Cr, Sc, Mo, Li, B).

Presence of positive correlation between hydrocarbon halos and active elements anomalies lends to the deduction that hydrocarbons migrating from oil and gas reservoirs affect on distribution elements in overlapping layers. These elements can be used for detecting chemical changes in the soils and rocks associated with the oil and gas deposits.

Important result of these studies litho geochemical survey pretty accurate showed board of Orenburg Gas Condensate Oilfield, which has very complicated geological structure.

Main advantage of using the complex litho and athmo geochemical methods is make geochemical surveys cheaper. Litho geochemical studies could be used to find out main regularities of the surveyed area. To approve anomalies discovered by litho geochemical surveys athmo geochemical and over methods should be used.

Key words: litho geochemical, survey, prospecting, oil, gas.

INTRODUCTION

Litho geochemical survey is indirect method for petroleum and gas prospecting. It was discovered some time ago that hydrocarbons escaping from subsurface accumulations and source beds cause changes in chemical composition of overlapped layers (Sokolov, 1972; Kartsev et al., 1959). Identifying secondary responses generated by leakage of hydrocarbons at the surface has been reported by many investigators. But till now there is no unique technic which allows by analyzing certain number of elements provide sufficient geochemical prospecting for oil and gas. Indeed number of elements providing response to the presence of oil and gas accumulations depends on each particular case: type of oilfield, composition of overlapped layers, surface conditions. This allows some scientists make a conclusion that litho geochemical survey can’t be used as efficient technic for petroleum and gas prospecting. Aim of this paper is to show successful example of application litho geochemical surveys over 5 oil and gas perspective structures.

Presence of positive correlation between hydrocarbon halos and active elements anomalies lends to the deduction that hydrocarbons migrating from oil and gas reservoirs affect on distribution elements in overlapping layers. These elements can be used for detecting chemical changes in the soils and rocks associated with the oil and gas deposits.

I discovered direct relationship between pH and Eh changes in surface layers, distribution of certain elements and value of hydrocarbons. This lands to the conclusion that redistribution of certain elements in surface layers are secondary responses generated by leakage of hydrocarbons.

Important result of these studies litho geochemical survey pretty accurate showed board of Orenburg Gas Condensate Oilfield, which has very complicated geological structure. This is good example of the case than direct methods couldn’t give sufficient result compare to litho geochemical survey.

METHOD AND RESULTS

The geochemical data came from 700 shallow probes (0.3 meters, 1 foot) soil samples and 700 shallow probes (2 meters, 6,6 foot) soil gas samples collected every 200 meters on 2 different profiles over 5 oil and gas perspective structures (Geochemical studies were handled in 2002 and 2004). The adsorbed soil gases were analyzed for methane, ethane, ethylene, propane, propylene, iso-butane and normal butane by gas chromatography using a Flame Ionization detector. Samples of soil were analyzed for number of elements using spectral analysis.

I discovered that there is some elements which distribution in the soil depends on presence oil and gas reservoirs. Those form halos marking structures perspective for oil and gas (Ni, Co, Cr, Sc, Mo, Li, B) – group number one (active elements) (Fig.1, Fig. 2). Others are indifferent to the presence of oil and gas reservoirs – group number two (i.e. Ti, Zr, Nb, V, Pb, Sn).

AESC2006, Melbourne, Australia.
Differences in distribution of elements from group one allow break it in to two subsets:
First form halos over the central part of oilfield (B, Cr, Mn, Sr); 2) Second form halos in the periphery - ring anomalies (Mo, Ba, Ni, Co).

There is a direct relationship between the quantity of sand material in soil and value of elements. There is positive correlation between hydrocarbon halos and active elements I discovered also direct relationship between pH and Eh changes in surface layers, distribution of certain elements and value of hydrocarbons (Fig 3). This lends to the deduction that redistribution of certain elements in surface layers are secondary responses generated by leakage of hydrocarbons. This agrees with literature (Horvitz, 1985).

Important result of these studies litho geochemical survey pretty accurate showed board of Orenburg Gas Condensate Oilfield, which has very complicated geological structure and wasn’t marked before by traditional direct geochemical surveys (Fig 2).

Main advantage of using the complex litho and athmo geochemical methods is make geochemical surveys cheaper. Litho geochemical studies could be used to find out main regularities of the surveyed area. To approve anomalies discovered by litho geochemical surveys athmo geochemical and over methods should be used.

Figures and Tables

Fig. 1 Distribution of “active” elements over Dimitrovskoe gas condensate oilfield.

Fig. 2. Distribution of “active” elements and methane over Berdyanskaia oil trap (1) and Orenburgskoe giant gas condensate oilfield (2).

Fig 3. Changes of Eh in oilfield site compare to background.

CONCLUSIONS

Distribution of certain elements on surface is very irregular and depends on vicinity of oil and gas accumulations. This allowed me to split them in to few different groups for following application: Mo, Ba, Ni and Co – can be used to determine borders of oil and gas structures; B, Cr, Mn and Sr – can be used to specify central part of oilfield; Ti, Zr, Nb, Pb, Sn - indifferent elements which can be use for math computations to increase signal to noise ratio for working elements. Direct relationship between pH and Eh changes in surface layers, distribution of certain elements and value of hydrocarbons lends to the deduction that redistribution of certain elements in surface layers are secondary responses generated by leakage of hydrocarbons. This agrees with literature.

REFERENCES

