GAS COMPOSITION IN MUTNOVSKY GEOTHERMAL FIELD: ROLE OF METEORIC WATER.

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The gas regime in the boreholes within geothermal field has been under the monitoring since June 2004. Water is a dominating component in the gaseous mixture. Fraction of other gases (He, H_2, N_2, Ar, O_2, CH_4, C_2H_6, CO_2, H_2S) is less than 1 mass % (fig. 1). H_2S and CO_2 usually comprise more than 90% among these gases. Nitrogen and oxygen rank second.

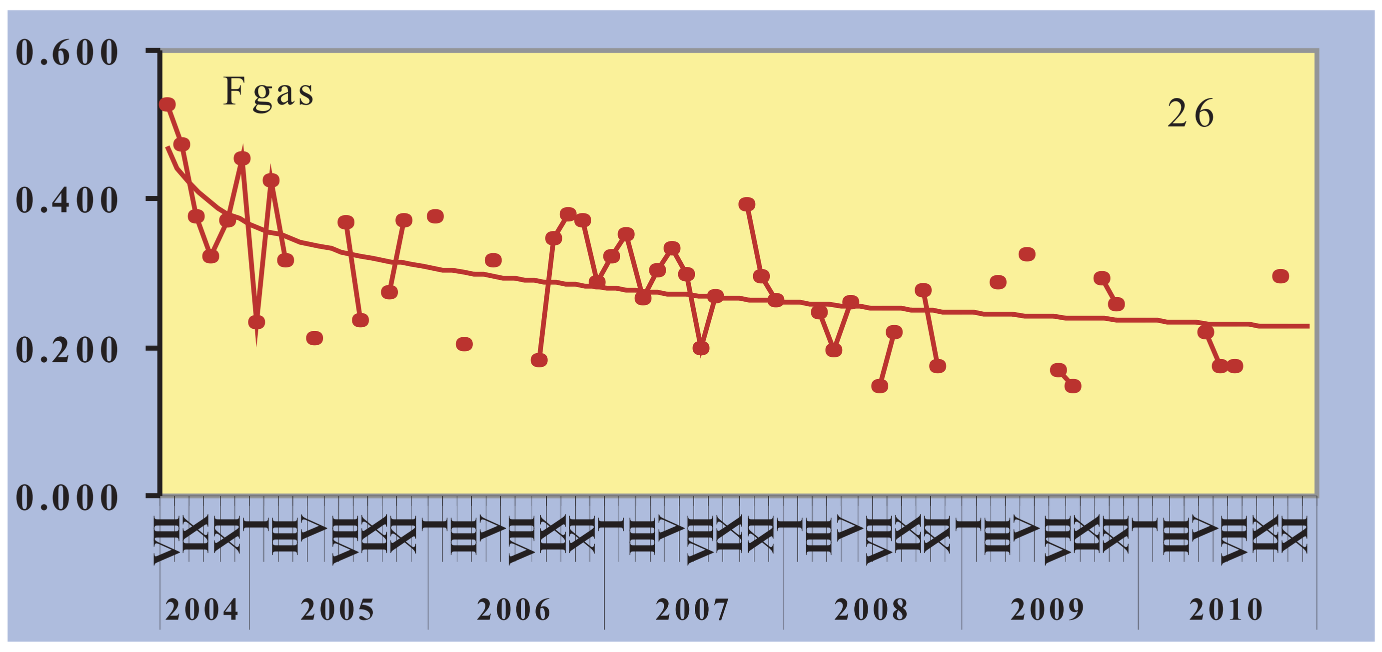

Fig. 1. Variations of gas fraction in borehole No 26 of Mutnovsky geothermal field during the time.

Analysis of oxygen, nitrogen, and argon relations in gases from Mutnovsky geothermal field revealed that their composition is influenced by 3 components: a deep fluid, meteoric water with dissolved air gas, and atmospheric air. Many samples show the O_2/N_2 relation in gases from various boreholes is higher in comparison to the relation in the air (fig.2). This obviously is caused by air gases delivered by meteoric water into the geothermal field, due to higher O_2/N_2 relation in dissolved gas in comparison to the relation in the air. Estimation of fractions of deep and meteoric components may provide a new data on hydrogeologic regime of the geothermal field.

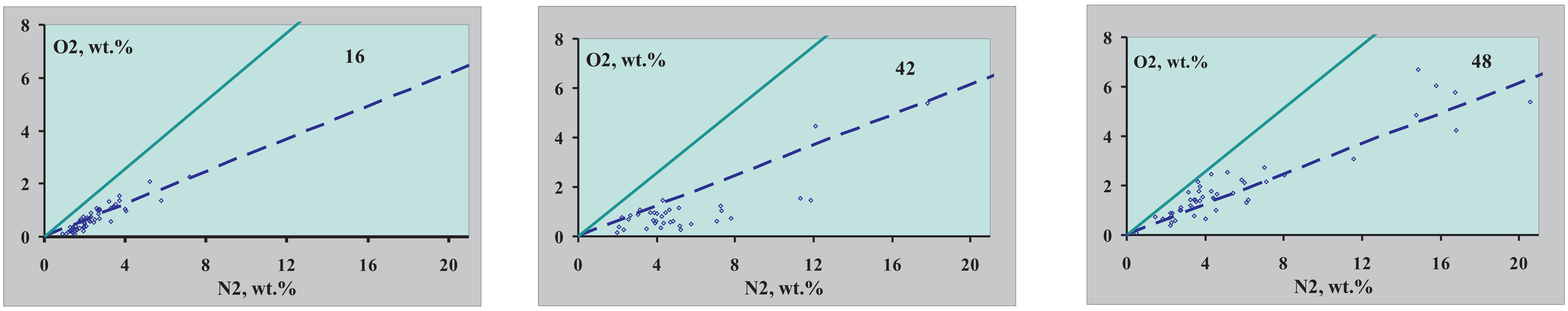

Fig. 2. $O_2 - N_2$ diagrams for gases from different boreholes of Mutnovsky geothermal field. 16, 42, 4Э, 48 – numbers of the boreholes.

Estimation of these fractions requires data on composition of geothermal gas, its part in the geothermal field, gas concentrations in meteoric water under a certain temperature, composition of common air, and composition of deep fluid. The later was derived with help of analysis of O_2-N_2-Ar*10 diagram (fig. 3). The majority of points of gas composition for various boreholes on the diagram are located within a triangle two vertexes of which indicate air composition and composition of gas dissolved in water. The third vertex lies on the N_2-Ar*10 side and corresponds to Ar*10/ N_2 ~ 0.19 –

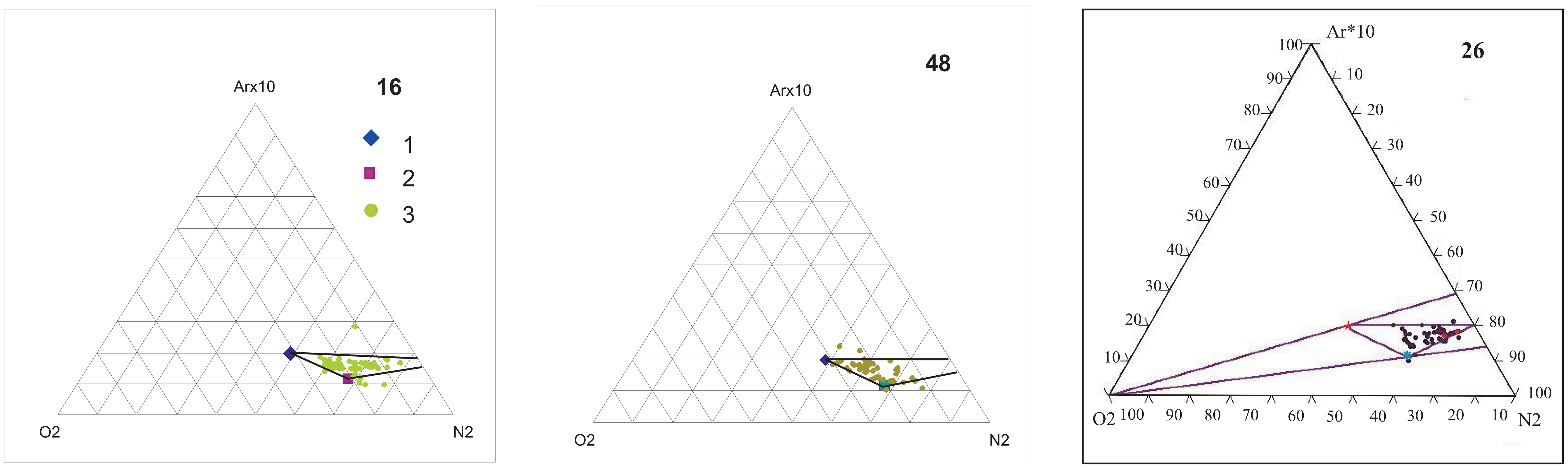

Fig. 3. N_2 – Ar*10 - O_2 relation in gases from different boreholes of Mutnovsky geothermal field.
1 - composition of atmospheric gas dissolved in water at 0°C;
2 - air;
3 - geothermal gases.

This data allowed us to estimate the fractions for hydrothermal, meteoric, and air components in the geothermal field in various boreholes. The part of the later is incredibly low, but influences the calculations significantly. The calculated part of meteoric component varies greatly from a few percent to more than 90% (fig.4).

The estimations are apparently doubtful due to inaccurate sampling and analysis, simple model for interaction between flows of deep fluid and meteoric waters, and certain assumptions. However, we suppose this method to be useful for calculation of composition of hydrothermal solution and analysis of processes in geothermal reservoir.

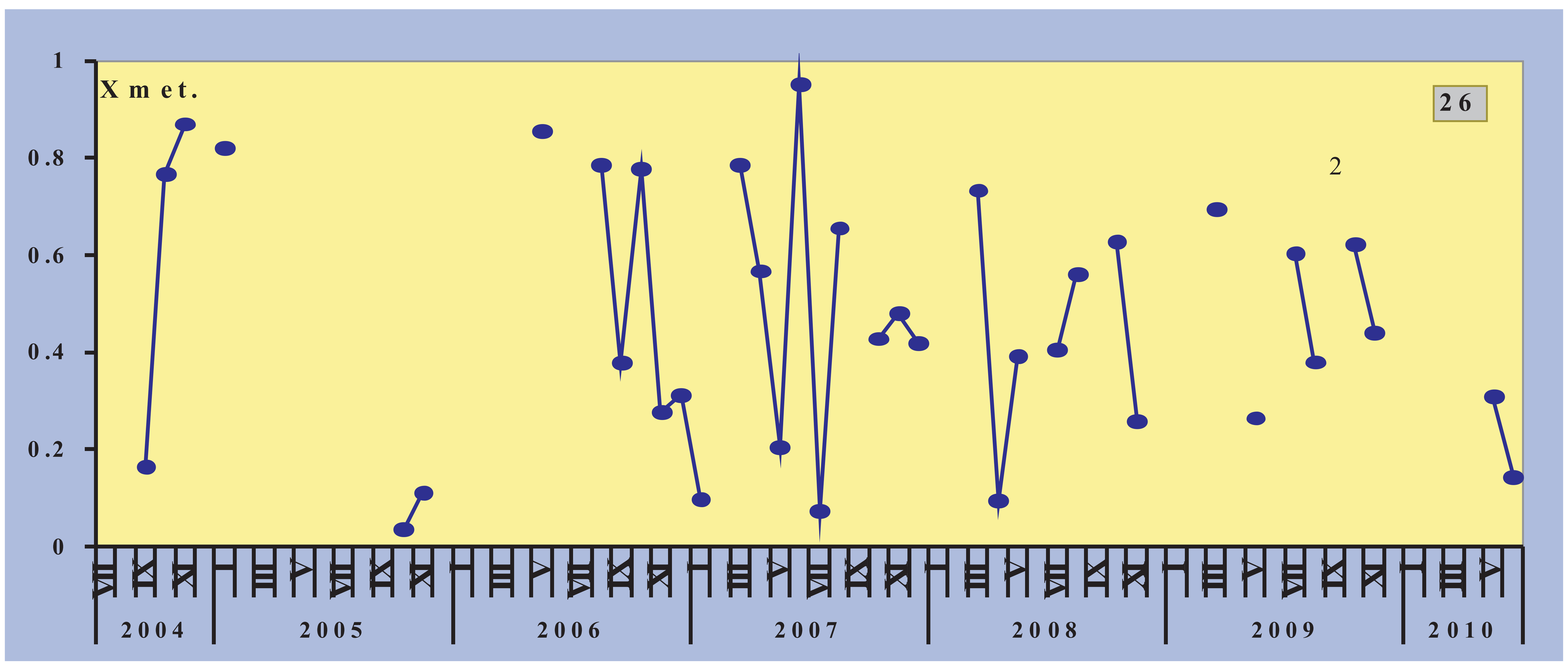

Fig. 4. Estimation of meteoric water fractions in geothermal fluid from borehole No 26.

1. Анализ соотношения кислорода, азота и аргона в газах теплоносителя Мутновского месторождения показал, что их состав формируется при участии трех составляющих: (1) глубинного флюида, (2) метеорных вод с растворенными воздушными газами и (3) атмосферного воздуха.
2. Отношение O_2/N_2 может служить оценочным критерием интенсивности водообмена геотермального резервуара с метеорными водами.
3. Предложен метод оценки доли метеорной воды в теплоносителе и состава глубинного флюида.
4. Изучение газового режима скважин может служить дополнительным источником информации о гидрогеологической обстановке месторождения.